ELECTRONICS Australia

HIFI NEWS

FEBRUARY, 1976
AUST $1.00* NZ $1.00

DUMMY HEAD MICROPHONE TESTING

INFRA RED PHONES
Story inside

COMPUTERS, PEOPLE AND THE FUTURE

BUILD YOUR OWN VIDEO TENNIS GAME FROM A KIT

Registered for posting as a periodical — Category B

How to get two Hi-Fi units for the price of one...

Sony's new Stereo Receivers (STR7025, 7035, 7055) (Component-quality Amplifier and FM-AM Tuner with 1.7 μV high sensitivity, 60dB selectivity)

Now that FM high fidelity stereo broadcasting is finally here, most hi-fi fans are adding a quality FM tuner to their rigs.

But newcomers to high fidelity (and those who are upgrading) are in luck . . . with Sony's new STR Series FM-AM Receivers, they can get *both* a component-quality tuner and a powerful amplifier for no extra cost.

Take the Sony STR7025, for instance. For under $350 you get a highly sensitive and selective FM-AM tuner, beautifully integrated with a 24 watt per channel stereo amplifier.

For anyone starting or improving a stereo system, the STR7025 is a great place to begin.

With Sony-engineered quality throughout, it will make even a cheap turntable or speakers sound better.

You get

- All the input and output controls you'd expect from Sony, including MIC mixing and four speaker outlets.
- Direct coupling for tighter, cleaner bass.
- Reserve power: 24 watts per channel (4 ohms) continuous RMS at 1 kHz.
- Low noise. Low distortion. S/N Phono 60 dB I.M.D. less than 0.8% at rated output.
- Frequency response: 30-40 kHz.

The tuner section's specifications are equally impressive:

- High sensitivity: 1.7 μV.
- Minimum interference is assured by FETs in the front end.
- Selectivity is 60 dB with solid state filters to reject adjacent channels.
- Extra wide tuning dial.
- Capture ratio as low as 1.5 dB.

The STR Series reflects Sony's usual crisp, appearance design, integrated here into an impressive whole. The two functions are of course wholly independent: your enjoyment is only limited by your own interest in experimenting with sound—beautiful sound by Sony.

Check out the STR Receiver Series at your Hi-Fi retailer soon. Sony STR7025, STR7035 and STR7055. One of them is the ideal source for your future stereo system.

SONY®

Research makes the difference

GAC.S.7552

ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine

VOLUME 37 No 11

Developed by Sennheiser, this headset system provides the viewer with TV sound carried to his favourite chair by means of invisible infra-red rays. Our story on page 13 has the details.

Complete kits of one of the home video games that are currently all the rage in Europe and the USA are now available in Australia. We assembled one of these kits and bring you our report on page 42.

On the cover

Two contrasting faces are shown on this month's front cover. The main view shows dummy head testing of Shure's new noise-cancelling microphone, the PE52, as described in the Hi-Fi News pages of the December 1975 issue. Inset, Sennheiser use an attractive model to display a developmental stereo headphone system using infra-red signal pick-up. See story commencing page 13, and also above.

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world of electronics and hi-fi

projects and technical

regular features

Editorial Viewpoint

Kits, bits . . . and a price rise!

Like most other business concerns, companies which cater for the do-it-yourself electronics market are facing tremendous cost pressures—so great, in fact, that not all of them have survived. The never-ending battle is to prevent mark-up profits being overtaken by labour and other operating costs.

Most such companies prefer to market complete kits for a few selected projects, because single transactions involving a fair outlay gives them the chance of offering an attractive all-up price, while still showing a workable profit. The cost of selling a randomly selected group of bits and pieces is proportionately much higher.

While we try to fit in with this concept as far as possible, it is too much to hope that everything we describe will warrant pre-packaging as a kit; or even that individual parts sellers will all apply the same value judgment to our efforts. Whether a particular project ends up as an advertised kit depends on the nature of the project, the inclination of individual retailers and on your own reaction as a group of readers.

The fact is, of course, that many readers want more than pre-digested designs aimed purely at the kit market. Our FM/AM tuner, for example (July-Oct '75) was primarily a design exercise for those readers who were clamouring for ideas and guidance; there was no way that such a tuner could compete price-wise with commercial tuners brought in cheaply from Asian sources. Again, we told readers how to experiment with "bucket brigade" devices for organ reverb and vibrato—even warning them that the method still fell short of more conventional systems!

In the near future we'll be describing circuits and modules for building up your own electronic organ but, typically, aspiring organ builders are going to pick and choose to meet their own needs. Its kit potential may perhaps be limited to basic modules and to a particular version which a parts seller may consider to be commercially viable.

What we are saying is simply this: don't expect every constructional article to emerge automatically as a kit. If some do, that's very convenient; if some don't, that's no reason to give up. Take the list of what you want and buy the parts individually. The more precisely stated your requirements, the more practical it will be to supply them efficiently.

Unfortunately, we too are facing cost pressures. Our Board had the option of cutting back quantity and quality, or adding another 20c to the cover price. They chose the latter. As editors and writers we detest price rises but then we don't have to balance the books at the end of the financial year!

—Neville Williams

ON SALE THE FIRST MONDAY OF EACH MONTH.

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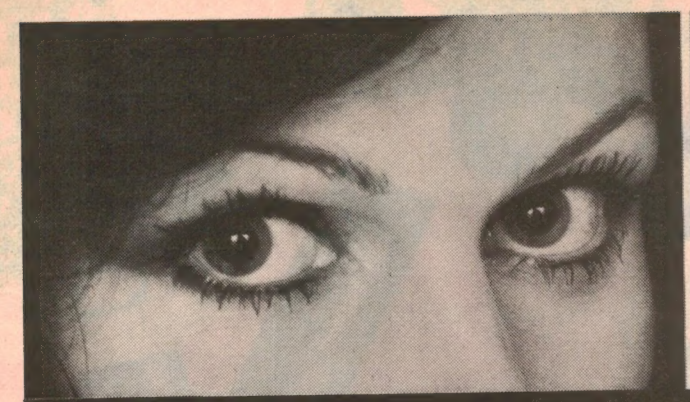

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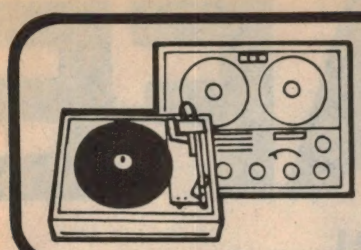

Hi Fi News

Widening horizons for the cassette

New styles of communication are coming into being thanks to a closer working partnership between specialists in various information fields. A commercial stimulus to develop them for the market is created partly by the wide availability of audio-cassette players (in Britain there are now said to be about 10 million in use) and partly through the survival tactics of newspapers facing multi-media competition.

by A. J. ARTHUR

"The Times" and "The Sunday Times" of London, two of the world's leading newspapers and owned by the same group—which also includes the Times Literary, Educational and Higher Educational Supplements—are among those which have taken an initiative in blending traditional journalism with the new media.

Their interests range from specialised book publishing with an educational slant to in-depth television programmes using newspaper investigation techniques.

Now they are bringing the same all-round approach to the field of audio cassettes. With a leading record company Phonogram, which markets the Philips, Mercury, Vertigo and Fontana labels, they offer what should be by April 1976 the biggest range of sound cassettes in the world, with programmes in various series—the World of Music, the World of Drama, the World of Literature, the World of Leisure and the World We Live In—running for at least an hour each.

To find out why these "Leisure and Learning" tapes are regarded as a novel concept in spoken word cassettes, I spoke to Derek Jewell in his office at Times Newspapers Ltd. Jewell is a man with a formidable grasp of the media, a broadcaster, novelist, expert on popular music, journalist and businessman. He is one of the executive editors of Times Cassettes and the tape on "Enjoying Pop" is his own creation.

As he described his many projects I realised that in answering my questions he was also telling me why newspapers are still needed. Starting point of these projects is the calculation that the editorial team and other resources of a great newspaper complex represent not only a huge concentration of expertise covering most aspects of modern life but a huge investment which the newspapers alone are increasingly unable to support.

The remedy of Times Newpapers is diversification—applying journalistic skills in other fields and often in alliance with the very media that are their biggest competitors.

The systematic business evaluation of what a newspaper's tangible and intangible assets really are has resulted in a variety of profitable enterprises.

Newspaper Archive Developments Ltd is a company subsidiary which sells a chronological microfilm of "The Times" to about 400 subscribers for use as an information bank. In the company's Publishing Division the top seller is the range of three Times Atlases, of which 350,000 copies have been sold in the last two-and-a-half years.

A further project is to make use of the reporting skills of "The Sunday Times" in a type of current affairs programme for television. The techniques of investigation which this newspaper has successfully developed are applied to television to produce a type of programme much more deeply researched than is usual for the medium.

Now Derek Jewell believes he has identified a mid-point where the needs of learning, communication and entertainment come profitably together. That mid-point is represented by a range of audio-cassettes presenting serious topics in entertaining form, using all the information resources of a modern newspaper.

A guiding principle has been to use journalists and authors to provide scripts, working with experts in particular fields—actors, musicians or sportsmen as the case may be.

For the first in the World of Drama series critic John Peter of "The Sunday Times" has adapted Christopher Marlowe's "Dr Faustus" in an hour-long production that loses little of the original, since intervals can be dispensed with.

In World of Literature four stories of Edgar Allan Poe are read by a well known author and broadcaster, Edgar Lustgarten. "The Sunday Times" music critic Felix Aprahamian is the commentator for "Enjoying Bach Harpsichord Music" (played by Colin Tilney). In a World of Leisure tape "Improve Your Driving" Judith Jackson and Jeremy Barrett speak to the kind of drivers so many of us become after years of motoring without a refresher course.

These "Leisure and Learning" tapes are not tied to an educational purpose—though schools may well use them—but are frankly commercial, combining information with high level entertainment, a success formula already proved in the quality newspaper field.

They were launched first in Britain (May 1975) but plans are well advanced to distribute them in many other countries.

PLAY SAFE

We hope you'll never need it!

THIS MAGAZINES SPECIAL OFFER!

There's a well known saying, that goes something like — "you shut the stable door after the horse has bolted". In the case of a handy fire extinguisher, not too many homes have them. Yet every year in homes, boats, cars, caravans and garden sheds, fires occur which could have been put out quickly and efficiently if a Chubb fire extinguisher had been handy. $14.95 is not much to pay for a feeling of security all year through. The model we offer readers is well designed and easy to operate. The body and operating mechanism is compact and made from plastic, which makes it rust proof and almost indestructable. It comes complete with a fixing bracket — ready to use!

The Dry Powder content is completely non-damaging and non-toxic in confined spaces. Fires fueled from petrol, oils, fats, lacquers, tar, alcohol, wood, paper and straw can be contained. The Chubb unit weigh s only 3 lb. 12 oz. (1.685 kgs.) and is 14.3/8" high (36.5 cm). Easy do-it-yourself refill kits are available. Each unit is carefully packaged and contains complete operating instructions.

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"Super Avilyn" cassette tapes

In the whole of the hifi field, it is doubtful whether any aspect has had closer, more tenacious and more competitive attention than the development of cassettes and cassette tapes. The latest one to appear on the hustings is TDK's Super Avilyn (SA) cassette, being handled in Australia by Convoy International.

The original audio tape, and most tapes since then, have used a ferric oxide coating, and virtually all domestic tape machines have been designed and adjusted to provide an appropriate order of high frequency bias and an appropriate amount of compensation for recording and playback. Both ferric tape and tape equipment have been progressively refined over the years but the convention of optimising bias and compensation for it has remained.

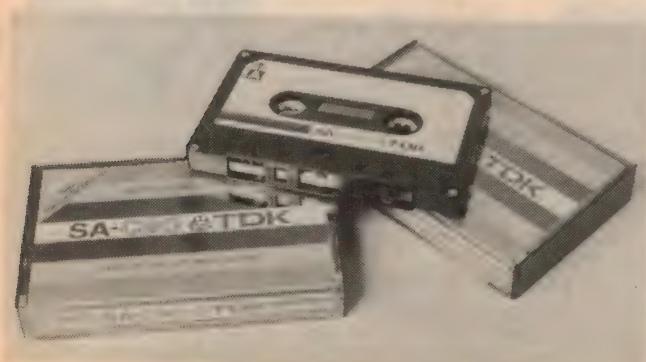
A few years ago, a breakaway technology evolved based on the use of a chromium dioxide coating, which held promise of a better signal/noise ratio and improved high frequency response. It did, however, call for different orders of erase, bias and compensation and, despite the release of many decks with a "CRO" facility, manufacturers have continued to refine ferric technology to the point where it suffers very little by comparison with the alternative formulation. They have also capitalised on the contention that chromium dioxide tends to produce a more abrasive coating, with consequently increased head wear.

Various compromise formulations have been introduced, in which a basic ferric oxide coating has been "doped" with cobalt or combined with a chromium dioxide layer to produce a definite 2-layer structure. "Okay in their way" say the competitors "but difficult to manufacture and a headache when it comes to quality control".

The new TDK "Super Avilyn" cassette tape is something else again, according to the manufacturers. It isn't a regular ferric oxide tape, it isn't a chromium dioxide tape, it isn't a two-layer tape and it isn't cobalt doped!

Basically, it is coated with very finely divided ferric oxide—giving its characteristic consistency and low abrasion qualities—but cobalt ions are added by absorption during manufacture to modify its magnetic characteristics.

The formulation was first introduced by TDK for their video tape and yielded a coercivity figure of 1400 Oersteds—said to be the highest figure ever in a regularly marketed product. For audio use in domestic recorders, the coercivity was deliberately lowered to 540 Oersteds to bring it into line with the chromium dioxide setting on most machines.



The new cassettes from TDK incorporating "Super Avilyn" tape. Although basically a ferric oxide formulation, it needs to be used with the deck switched to the "CRO" position. Local tests have indicated that the performance is indeed very good.

NEW HIFI SYSTEM FROM PIONEER

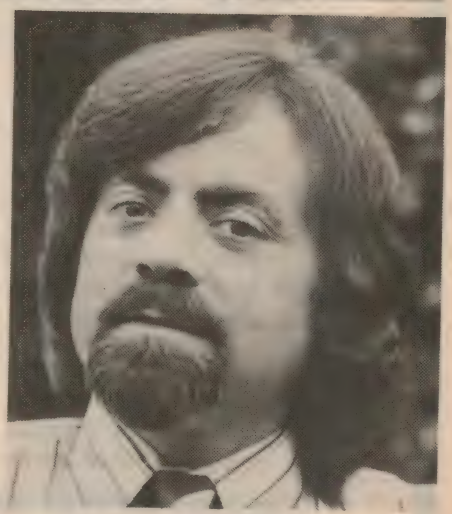
Although hardly the place to listen to hifi music, this rocky outcrop is a good backdrop to display to advantage the new Pioneer Prelude 700 sound system.

The new hifi system is aimed specifically at bridging the "speaker gap" which Pioneer felt had previously existed between the $300 and $500 price range. It utilises the same amplifier and turntable as the popular Prelude 600 sound system, but incorporates a specially designed pair of 2-way speaker systems to satisfy more critical customers.

The belt-drive turntable uses a magnetic cartridge, and is housed on a base with a hinged and sprung cover. The amplifier is the model SA5300. It offers full control facilities, provision for tape and tuner input, and provision to switch in two pairs of loudspeakers, separately or together. Available power output is 14W RMS per channel.

Recommended retail price for the Prelude 700 is $389. The utility stand shown in the photograph is an optional extra.

Pioneer has also advised the appointment of Mr Noel Brown (pictured) as Publicity/Promotions Officer.



Previously a director of Kaleidazee Pty Ltd, Mr Brown's background includes specialist promotional functions for several major Australian companies. He now assumes responsibility for publicity and promotion of all products marketed through Pioneer's Hi-Fi and Car-Stereo divisons. (Pioneer Electronics Australia Pty Ltd, 178 Boundary Rd, Braeside, Victoria 3195.)

HI FI NEWS—continued

TDK admit that this will inevitably cause some confusion because, for the first time, what is essentially a ferric oxide tape has appeared on the market requiring a "CRO" setting for the bias and erase, and a replay equalisation of 70 microseconds.

As a pay-off, however, TDK engineers claim that their Super Avilyn tape will yield a signal/noise ratio some 5-7dB better than ordinary high quality ferric oxide tape. This, in addition to high output and extended frequency response. These advantages will be realised provided users accept the idea—and follow the instructions—about switching their deck to "CRO" whenever a Super Avilyn cassette is in use.

Some decks, of course, have sensing fingers which respond to the cut-out commonly provided in the rear of chromium-dioxide cassettes. The new Super Avilyn cassettes have this cut-out so that the appropriate bias change will be effected automatically in such decks.

(For further information on TDK Super Avilyn cartridges: Convoy International Pty. Ltd., 4 Dowling St., Woolloomooloo NSW 2011.)

SOUND MIXING CONSOLES: Following its release of a new mixer range at the IREE exhibition last August, Philips Vision and Sound in Melbourne has received several orders. These include sales of an LDN 5664 6-channel mono mixer to radio station 3EA, Melbourne's first ethnic AM station, and two LDN 5660 12-channel stereo units to the ABC.

The concept behind the 6-channel LDN 5664 was a low cost, announcer-operated mixer for AM broadcasting in Australia, New Zealand and South-East Asia. Developed by Philips Vision and Sound in Huntingdale, Victoria, it features two microphone inputs, two equalised pick-up inputs, two high-level inputs for tape machines, and one output channel.

Facilities provided by the LDN 5664 include in-built monitoring, cueing and talk-back, as well as facilities for signalling, cue lights and machine starts. An optional clip-on attachment can be used to convert the rotary faders to straightline.

The "big brother" LDN 5665 features 12 input channels and two output channels. Apart from the obvious increased flexibility beyond the 6-channel mixer, it provides clean feeds for

(continued next page)

RECORD DIVISION CHANGES AT EMI

A series of organisational changes sanctioned by Chairman Mr. John M. Kuipers were announced to senior interstate Branch personnel at a conference held at North Sydney's Northside Gardens by Managing Director of the Record Division, Mr. Stephen Shrimpton.

The restructuring of the Division has Brian Harris, formerly National Sales Manager, appointed to the position of Marketing Manager.

The position of National Sales Manager vacated by Brian Harris has been filled by Michael Farrer, who rejoins EMI.

Geoff Weule, formerly Marketing Manager, has been appointed Australian Artists and Repertoire Manager.

Terry Howard, former Promotions Manager, now heads the newly formed Public Relations Department.

Brian Harris

The newly created position of Marketing Services Manager has been filled by the former Sales Administration Manager, David Wyatt.

Former EMI Label Manager, Les Hodge, has been appointed as Senior Product Manager for the Division.

The Arista/Bell Product Manager, Roger Langford, has, in addition to this, been appointed to the newly created position of Promotions Co-ordinator.

such functions as simultaneous telephone talk-back, sound recording and broadcasting, and the ability to feed two separate networks.

The two LDN 5660 stereo mixers purchased by the ABC were custom-made expecially for the new ABC FM source station in Adelaide. The new FM station is scheduled to begin operation in January 1976, with broadcasts from Sydney, Melbourne and Canberra, as well as from the Adelaide broadcast centre itself.

Featuring 12 input and two output channels the LDN 5660s will be used mainly for live announcer presentation and for making tapes for later broadcasts. Switches are touch sensitive with no mechanical action, ensuring that an announcer's transmission will be uniterrupted by the operation of auxiliary equipment.

The mixer console is fitted with comprehensive stereo monitoring, in-built line-up oscillator and talk-back facilities, as well as insertion points for time signals. There are also facilities for providing mono output simultaneously with stereo. Each input channel can be used either as a high level or as a microphone source.

Another new range of audio mixers is the **"Triad"** range of sound mixing consoles. These are manufactured in England by **Trident Audio Development Limited,** London, who are represented in Australia by the John Barry Group of Companies, 105 Reserve Rd, Artarmon, Sydney, 2064.

The triad consoles are made in two distinct ranges: The "A" series, designed for larger studio installations; and the "B" series, a moderately priced comprehensive range available in standard configuration with 18 input channels, 8 output groups, and 16 monitor returns. Consoles can be made to order, and virtually any number of inputs and outputs can be supplied.

Comprehensive patching facilities are provided and each console is supplied complete with high quality power supplies. Microphone phantom powering is provided as standard. Metering is normally provided by 17 VU meters, including 16 reading group outputs and one auxiliary which may be switched to read echo, foldback or oscillator levels.

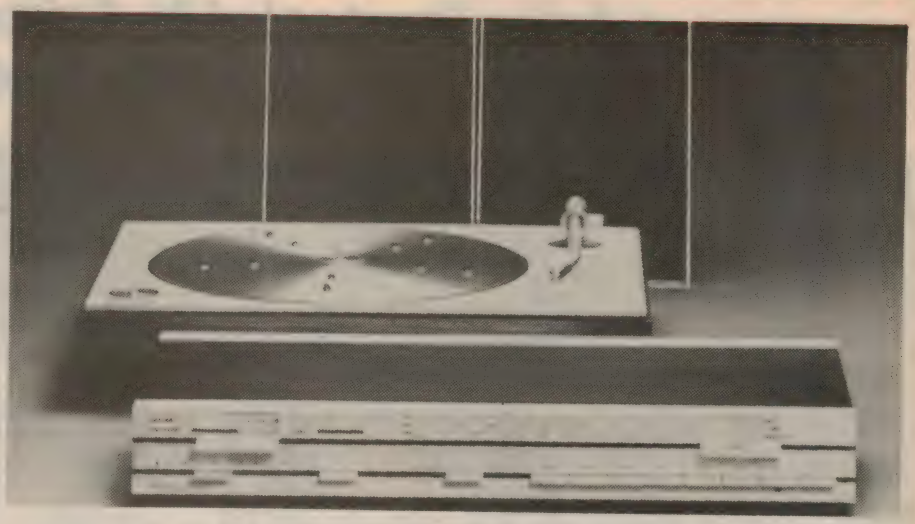
12/12 WARRANTIES: A full 12 month warranty covering parts and labour for all Toshiba brand domestic products marketed in Australia has been announced by Toshiba-EMI (Australia) Pty Ltd, the recently formed joint venture company which commenced operations on November 1, 1975.

The new 12/12 warranty covers Toshiba colour and monochrome television sets, portable radio and cassette recorders, and the company's full range of hifi equipment.

Coinciding with the Toshiba-EMI announcement, Aiwa have also announced a 12 months' parts and labour warranty on all equipment sold in Australia. The warranty is retrospective to stock equipment invoiced to retailers as from June 1, 1975.

Aiwa advise that service agents and facilities have been established in all states, in addition to the service facility and warehouse/office complex at Arncliffe in Sydney.

BANG & OLUFSEN ANNIVERSARY OFFER



This year, the famous Danish firm Bang & Olufsen is celebrating its 50th anniversary around the world. And to mark the occasion, B & O are offering their "Anniversary System"—$1015 worth of sound equipment for $695!

The equipment offer includes a pair of Uni-Phase S.30 loudspeakers rated at 30W RMS each; the Beomaster 901 Stereo Tuner/Amplifier; and the Beogram 1203 Record Player. The model 901 features a stereo FM/AM tuner, with AFC for FM. Power output from the power amplifiers is rated at 20W RMS.

The 1203 record player is fully automatic, and employs a single press-button control for simplicity of operation. The turntable and pick-up arm are mounted on a separate floating sub-assembly to minimise the effect of vibrations on the pick-up. The magnetic pick-up cartridge tracks at under two grams.

B & O emphasise that the offer is not a "cloaked attempt to clear stocks of a superseded model or a disguised effort to accelerate sales of a slow moving line". The anniversary system is covered by the normal B & O one year guarantee.

If you're interested, be quick about it. The offer only holds good until the 28th February 1976. In Sydney, contact Convoy Technocentre, 1 Maclean St, Woolloomooloo 2011; in Melbourne Danish Hi Fi at Southern Cross Plaza and Burke Rd, Camberwell.

SCAN-SPEAK LOUDSPEAKERS: Danish loudspeaker manufacturer Scan-Speak, recently taken over by Ortofon, is now marketing its new range of Scansonic speaker systems in Australia.

The new speaker systems are actually available in three ranges, each range incorporating three models. These are the "Professional Range", the "High-Fidelity Range", and the "Stereo Range". The two up-market ranges incorporate the new "SD-System" speakers.

Basically, the SD-System refers to a magnet system and a voice coil construction with position-independent inductance. Claimed advantages are symmetric impulse response, reduced intermodulation and time delay distortion, and linear impedance which simplifies filter design.

The top of the market Professional Range consists of three different 3-way speaker systems, each housed in a sealed enclosure. The most expensive model, the P-55, is somewhat unusual in that the internal cavity is divided into two chambers connected by an internal driver unit. The midrange and tweeter units are housed together in one chamber, with the "external" driver unit located in the other.

The High-Fidelity Range offers three different 2-way speaker systems, each employing the Scan-Speak 1½" dome tweeter. Driver sizes are 7", 8" and 10" for the H-10, H-20 and H-30 models respectively. Power ratings are from 30W to 60W. Enclosures are bass reflex.

At the bottom of the market are the three models from the Stereo Range, the two larger models, the S-12 and the S-22, being 2-way systems. No details on the smaller S-02 model are yet known. Enclosures are presumably bass reflex, as for the High-Fidelity range.

Scan-Speak are represented in Australia by Duratone Hi-Fi Pty Ltd, 3A Botany St, Philip, ACT 2606.

Top Disc Cutting Studios, like The Mastering Lab, rely on Stanton's 681-Calibration Standard in their Operations.

Not everyone who *plays* records needs the Stanton Calibration Standard cartridge, but everyone who *makes* records does!

At The Mastering Lab, one of the world's leading independent disc mastering facilities, the Stanton 681 Triple-E is the measuring standard which determines whether a "cut" survives or perishes into oblivion.

A recording lathe operator needs the most accurate playback possible, and his constant comparing of lacquer discs to their original source enables him to objectively select the most faithful cartridge. No amount of laboratory testing can reveal true musical accuracy. This accuracy is why the Stanton 681 Series is the choice of leading studios.

When Mike Reese, principal disc cutter at The Mastering Lab, plays back test cuts, he is checking the calibration of the cutting channel, the cutter head, cutting stylus, and the lacquer disc. The most stringent test of all, the evaluation of direct to disc recordings, requires an absolutely reliable playback cartridge . . . the 681 Triple-E.

All Stanton Calibration Standard cartridges are guaranteed to meet specification within exacting limits. Their warranty, an individual calibration test result, comes packed with each unit. For the technological needs of the recording and broadcast industries, and for the fullest enjoyment of home entertainment, you can rely on the professional quality of Stanton products.

stanton

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The Sennheiser HDI 406 headset which receives its signal via modulated infra-red light entering through the filter bezel on the right. The switch/volume control is on the left while the tiny unit underneath is the plug-in battery pack and charger.

TV SOUND IN THE RED—INFRA-RED!

With a television screens all over Australia displaying pictures in a wide range of visible colours, some at least may soon be listening to the accompanying sound in a particularly uncoloured way: carried right to their easy chair on an ambient of invisible infra-red rays, filling every nook and cranny in the viewing room.

by NEVILLE WILLIAMS

While TV sound normally—and logically—comes from a loudspeaker adjacent to the screen, there are plenty of occasions when it would be an advantage to listen via headphones—if only they didn't involve long trailing cords! Various systems have been devised to overcome the trailing cord problem, the latest being the use of modulated infra-red rays, emitted from the receiver and picked up by receptors attached to the headphones —"wireless" reception indeed!

Mainly a brainchild of the European electronics industry, the infra-red idea has actually been around for several years but it was underscored recently by a news item from Siemens, which we reprinted in our April '75 issue. It mentioned the release of their type LD 241 luminescent diodes intended to be used as infra-red transmitters; a bank of four was credited with a peak power output of 60mW—sufficient to "illuminate" an average room—while bank of 8 producing 120mW could cope with a very large room or a small auditorium. Wavelength of the light is centred on about 930 nm.

For the receptors, Siemens were offering their BPW 34 Si-PIN photodiode to feed the circuitry associated with the phones, and necessary to translate the infra red signals back into ordinary audio currents.

The release went on to assure the reader that infra-red radiation has the ability to "flood" rooms, being notably free from shadowing effects, dead areas, etc.

It was not immediately clear how receptors could distinguish between the wanted signals and infra red energy from room lights, or other sources, although a hint was given by reference to optical filters and the use of frequency modulation. The basic principles have since become much clearer.

Companies which have been mentioned as "in on the act" now include Blaupunkt, Grundig, ITT (with brand names Graetz and Schaub-Lorenz), Loewe-Opta, Metz, Nordmende, Saba, and Siemens, while the headphone makers include AKG, Beyer and Sennheiser.

All use basically the same prinicple: the infra-red is produced by a number of light emitting diodes, their output being pulsed at a frequency, usually centred around about 95kHz. The pulse rate is modulated, however, by the audio information so that what is carried by the infra-red is actually a pulse/frequency modulated sub-carrier. At the receiving end, it is passed through limiter stages and demodulated as an FM signal, substantially eliminating amplitude modulated energy which might come from ordinary room lighting.

Most units operate with a sub-carrier frequency of 95kHz deviated by up to 50kHz. However, others operate at up to 100kHz, or at 93.75kHz (sixth harmonic of the TV line frequency), while deviation can be as small as 5kHz.

The Sennheiser SI 406 infra-red transmitter is intended to mount flush underneath a TV receiver, or to rest on top of it, with the six infra-red diodes facing towards the viewing position. The power supply is a separate compact unit which can plug directly into a power point or be otherwise mounted adjacent to the receiver. Some European TV receivers have the infra-red transmission built in as an integral part of the design.

The case for cassettes...

Who better than Sony to develop a cassette deck that genuinely rivals open reel in performance. After all, Sony made its name by leading the way in open reel technology. That same brilliant Sony engineering now brings you the TC-177SD, a superb instrument for cassette fans.

Consider: Wow and flutter less than 0.07%; Frequency response 20Hz to 20kHz; Signal to noise of 55dB (and even better with Dolby on). All that and cassette convenience!

Sony did it by combining its proven closed-loop dual capstan drive with a number of remarkable new cassette deck developments. First, the TC-177SD has three heads for separate erase, record and replay. This ingenious design avoids the compromise between record/playback head design and permits A/B monitoring of sources and just recorded signals for instant checking.

Second, the TC-177SD is unique in providing Bias/Equalisation switching so that Sony's fantastic new Ferri-Chrome and the normal chrome dioxide tapes can be "tuned" for ideal balance in recording. Naturally Dolby noise reduction is inbuilt. But with a typically Sony difference; four Dolby circuits provide such super features as Dolby monitoring, there's a Dolby oscillator for optimising the particular tape in use, and for Dolby-encoded broadcast FM.

Functions, too, are up to the highest reel standard: feather touch control buttons; FM multiplex filter; full mixing for microphone and line inputs; peak level indicators are LED to complement the Limiter and 2 large VU meters; a memory counter for auto location of desired part, and there's an auto shut-off.

Everything you've wanted for easy, professional-quality cassette recording is now together in the fabulous Sony TC-177SD.

See it and hear it, soon.

Sony TC-177SD puts 3 heads together

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Pre-emphasis of 50uS appears to be standard, with an audio bandwidth in the range 40Hz to 12kHz and distortion levels between 1 and 3%.

Manufacturers' measurements in a fairly large room (4 x 6 x 3 metres) served by a 60mW transmitter typically give signal/noise ratios of up to 60dB in daylight (200 lux) and 40-50dB when the receiver is facing away from the transmitter. All these figures are compatible with requirements for listening to TV sound, as distinct from state-of-the-art hifi.

The finer details of the various systems are somewhat difficult to sort out at present, partly because of the language difficulties, and partly because individual companies are being both secretive and tentative in their approach to what is a very new market. For example, what is the best way to derive the signal from the TV receiver for infra-red transmission?

A number of approaches are possible. For example, by picking up the 5.5MHz TV intercarrier sound IF and beating it with a 5.405MHz local oscillator one resultant will be a 95kHz carrier, ready to superimpose on the infra red, and already frequency modulated to 50kHz and pre-emphasised by 50uS. The system is very straightforward, with deviation locked to the basic TV signal, and entirely independent of the receiver audio circuits or volume control setting. The disadvantage—if it be one—is that the sub-carrier for the headphone system must be deviated to full TV standards, whether or not they are technically convenient for the infra-red cicuitry.

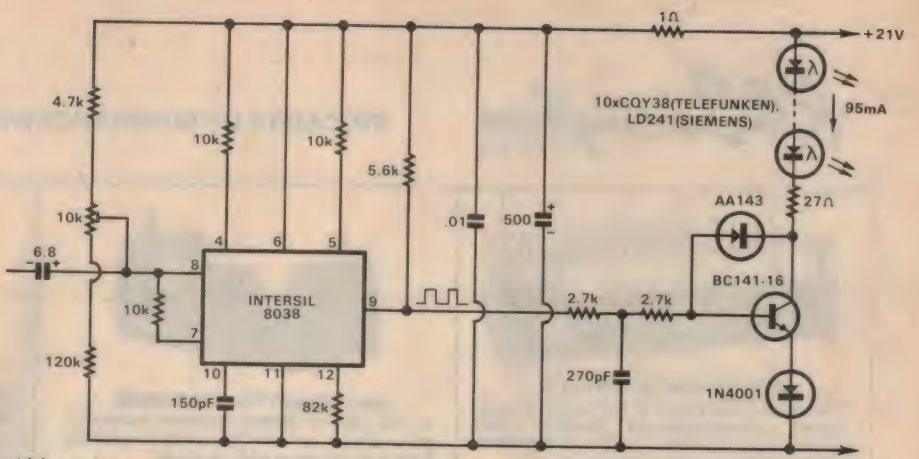
Alternatively, the sound signal can be derived at 5.5MHz, separately demodulated to audio in the infra-red transmitter, then remodulated on to a locally generated 95kHz sub-carrier. This system also remains independent of the TV receiver's own audio circuitry and it does allow a deliberate choice of the sub-carrier deviation. Overall, however, the circuitry is more complex and costly than the direct conversion method.

A still further option is to derive the audio signal from the TV receiver audio system, for modulation on to the infra-red sub-carrier. The method is basically simple, particularly if access can be had through an existing headphone or external speaker outlet. The main problem is likely to be that deviation will be dependent on the volume control setting at the receiver.

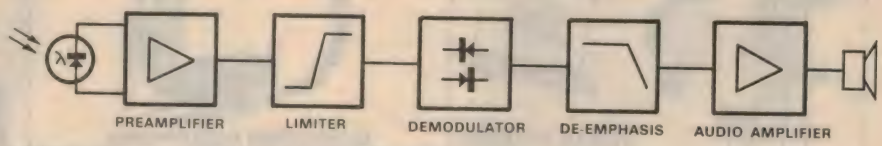
Along general lines, there appears to be some reservation about the life expectancy of light emitting diodes, used in a transmitting role, where they are likely to be on for long periods and operating at relatively high dissipation. In this respect, the headphone application differs markedly from a low dissipation "indicator" role for LEDs, or their use in a short-term control function, where they spasmodically change channels, modify level and brightness, etc.

(Questioned about this aspect, Sennheiser's representatives in Australia telexed the factory and were informed that no problems were anticipated on this score. Indications were that the infra-red diodes would give many years of useful service.)

Pulse/frequency modulated operation would help in this respect by reducing the duty cycle by typically 50%. However, some engineers are apprehensive about the use of rectangular pulses and the resulting harmonic radiation at frequencies outside the already wide passband 35 to 155kHz. They see the need to obviate unnecessary radiation in order to leave the way open for the use of other infra-red systems within the same room space—as, for example, TV sound and hifi stereo.



Although not necessarily representing the circuit of the current production type unit, this diagram was released by Sennheiser to indicate the basic operation of the infra-red transmitter. It propagates audio derived from the TV set's own audio system, usually via the earphone or external loudspeaker outlet.

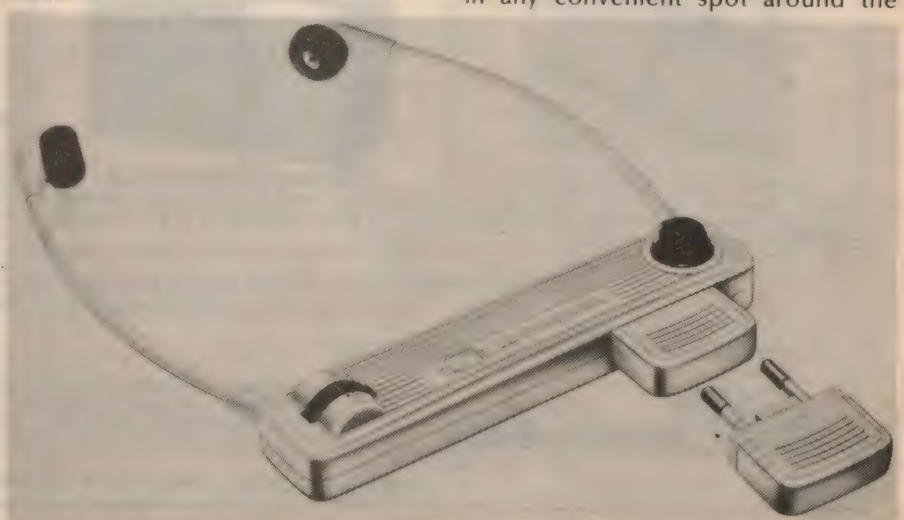


A block diagram of the HDI 406 infra-red receiver. Being designed for a sub-carrier of 95kHz, deviated by up to 50kHz, the receiver can be used with most transmitters. Receivers designed for narrow band operation are more restricted in their use, tending to distort badly when faced with a full 50kHz deviation.

Getting back to specifics, the equipment currently being marketed by Sennheiser is shown in the accompanying photographs.

The transmitter (type SI406) is housed in a slim package measuring approximately 200 x 80 x 17mm, finished in dull black and intended for mounting to the underside of the TV cabinet. It radiates infra red from a bank of six light emitting diodes, bearing a carrier at 95kHz, deviated ± 50kHz, and with a 50uS pre-emphasis – the recommended industry figures.

The transmitter is powered from a separate supply, which can be installed in any convenient spot around the



The HDI 046 infra-red receptor headset, providing mono sound but fed to both ears. Two battery pack/chargers are shown, one plugged in, the other as it appears when withdrawn. The unit is styled to suit European power outlets with two round, active pins. Suitable alternative provision will have to be made for Australian conditions.

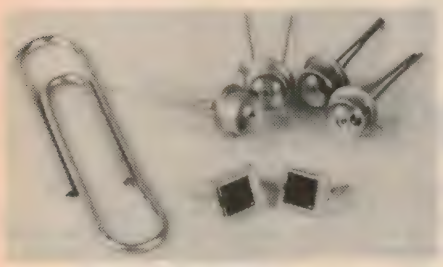
receiver, operating from 220V, 50Hz at 3W. Audio signal is picked up normally from a headphone or external loudspeaker output, and internal circuitry permits operation from an extremely wide range of input level—from 10mV to 1V.

Being able to accommodate such a wide range of signal levels, and being switched on and off automatically by the incoming audio signal, the transmitter is very much a fit-and-forget item, with no user controls whatever. Unless deliberately deactivated, it simply comes on and radiates infra-red whenever the TV set is turned on.

The Sennheiser receiver/headphone unit, as pictured, has the type number HDI 406. The maker's block diagram shows that it contains a receiving diode behind a filter/lens, a preamplifier, limiter stage, demodulator, de-emphasis network and an audio amplifier feeding the output transducer. A thumbwheel volume control provides off-on control and volume level. Being intended for present-day TV sound, the HDI 406 contains mono facilities only.

All this is contained in a compact housing light enough to be supported from the ears by two slender stethoscope type acoustic tubes. All-up weight of the headset is about 70gm—apparently much lighter than any of its competitive units.

Power supply for the receiver is provided by two tiny NiCd cells contained in a small housing which plugs directly into the bottom of the receiver, and giving an operate time of about 5 hours. The plug-in battery housing contains all the necessary components for a charging circuit and it is simply necessary to detach the battery pack and plug it straight into a wall power socket



Heart of the infra red system are the Siemens photodiode receptors in the foreground (BPW 34) and, behind them, the light emitting diodes type LD 241. As pictured, they are about normal size.

(European style, as pictured). Charging current is about 1.5mA, charging time 5-20 hours, with full protection against inadvertent overcharge. In fact, the battery pack can be left in an active wall plug whenever it is not in use.

Maximum sound pressure level (SPL) from the HDI 406 headset is 104dB, which is ample for all normal listening requirements.

However, Sennheiser have given special consideration to the needs of these with a hearing impairment and who may need high level headphone sound, whether or not a loudspeaker is operating simultaneously. Their SI-406-S transmitter, distinguished from the normal unit only by a yellow dot on the housing, provides additional compression of the audio signal, ensuring that the listener has adequate level at all times, without embarrassing signal peaks.

Sennheiser can also supply a headset in specialised form, intended for use with the SI 406-S and optimised for listeners with a hearing deficiency.

A further interesting item, being offered in the European market, but not currently in the Sennheiser range, is a small receptor intended for use in conjunction with tape recorders and hifi systems. Signals can be picked up from the TV receiver and recorded or amplified, without the need for additional connecting cables.

One interesting area that Sennheiser are all set to develop is the provision of personalised sound in churches, auditoria, cinemas and theatres. Their higher-powered SI 1010 infra-red transmitter can illuminate an area of, typically, 200 sq. metres, with the possibility of using multiple units to cover even larger areas. Transmission standards are the same as for the smaller SI 406 so that listeners can use HD 406 or HDI 406-S headphones.

For homes for the aged, or for institutions where hearing impairment is prevalent, a special version of the SI 1010 transmitter can provide additional volume compression.

And what of stereo reception via infra red? Here Sennheiser, along with other manufacturers, seem to be keeping their options open, at least until they see what kind of a market opens up for the mono system.

Stereo infra-red headsets have been produced and demonstrated and, superficially, they appear to be very attractive. A transmitter is placed on top of the stereo amplifier and plugged into the normal stereo headphone jack. The listener relaxes in his/her favourite seat with a small receptor nearby, plugs in the normal stereo headset and enjoys the program.

But would the dedicated hifi enthusiast really do that or would they be too apprehensive about possible distortion introduced by the additional signal processing? Furthermore, because they do not need to position themselves relative to a viewing screen, do stereo listeners find the headphone cord as much a problem.

And, of course, there is the consideration mentioned earlier: a living area can be illuminated with infra-red carrying a single audio signal, without too much attention to bandwidth. Two simultaneous signals would call for much tighter control, and three signals—simultaneous TV and stereo—would push the need for standards even further.

Ultimate development of the stereo market is probably inevitable but no one is rushing in at the moment.

(Sennheiser is represented in Australia by R. H. Cunningham Pty. Ltd., 493-499 Victoria St., West Melbourne, and in other capital cities.)

SENNHEISER LOW IMPEDANCE PHONES

Sennheiser headphones—traditionally of high impedance—are unlikely to be overloaded by any hifi amplifier, but sometimes lack sensitivity when monitoring the signal through a tape deck. Sennheiser have accordingly brought out "X" versions of their popular HD-414 and HD-424 headphones, the suffix indicating lower impedance. On test, the HD-414 phones pictured impressed with their comfort and light weight. Our impression is that sensitivity for tape deck monitoring is still somewhat below average, but they certainly performed well directly from an amplifier, with clean, wide-range sound. (Details from R. H. Cunningham Pty Ltd, 493-9 Victoria St, West Melbourne.)

Announcing Bang & Olufsen's 50th. Anniversary present-to you!

More than $1000 worth of the world's most advanced stereo sound equipment-for $695.

When a company of Bang & Olufsen's high international repute celebrates an anniversary, you can be sure the offer they make is not a cloaked attempt to clear stocks of a superseded model or a disguised effort to accelerate sales of a slow moving line.
Just the reverse–for instance, the B & O 50th Anniversary System offered here includes the world's most recent development in loudspeaker technology–two new B & O Uni-Phase speakers. **This loudspeaker system was released in Australia in October 1975!**

HERE'S WHAT YOU GET IN THE BANG & OLUFSEN 50TH ANNIVERSARY SYSTEM.

1. The Beomaster 901 Stereo Tuner/Amplifier A stereo amplifier combined with a stereo FM and Medium Wave radio tuner. The Beomaster 901 includes AFC (Automatic Frequency Control) which keeps the radio tuned in to the desired FM station.
The stereo amplifier has a 2 x 20 watts RMS output, which is more than sufficient in most homes.
The exclusive Darlington output stage provides for less than 0.5% distortion at full power.
There are, of course, inputs for turntable and tape recorder, and outputs for headphones and two pairs of stereo loudspeakers.

2. The Beogram 1203 Record-Player A fully automatic stereo record-player with high fidelity specifications. With its single press-button control, nothing could be easier to operate. The turntable and pick-up arm are mounted on a separate floating sub-assembly preventing vibrations effecting the tracking of the pick-up cartridge.
The special pick-up cartridge–the SP14A–has a spherical diamond stylus and a tracking pressure of under two grams, protecting your records from wear. The unit comes complete with hinged cover.

3. The Beovox Uni-Phase S.30 Loudspeakers From Bang & Olufsen's new range of Uni-Phase loudspeakers, a pair of S.30's with a power handling capacity of 30 watts RMS each. The most outstanding features of the Uni-Phase S30's is that they take up much less room than conventional pressure chamber loudspeakers of a comparable power handling capacity. As well, they produce sound more accurately than most commercial loudspeakers on the market to date.

4. The Bang & Olufsen Guarantee Your B & O 50th Anniversary System is covered by the normal one year guarantee for both parts and labour.

The Bang & Olufsen 50th Anniversary Offer is a genuine price reduction made possible by Bang & Olufsen of Denmark celebrating 50 years of designing and producing the world's most advanced sound equipment. As a result, this complete system which normally retails for $1,015.00 is offered at $695.00 for a period limited to three calendar months from December 1st, 1975.

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BO/720MM

dbx 119 dynamic range enhancer

Most recordings of music are made with some degree of compression to allow for the limited dynamic range of the medium. One way to recover the lost dynamic range is to employ the dbx 119 dynamic range enhancer. It can increase the dynamic range on tapes and records by up to 20dB.

As befits an unusual product, the name is unusual in that "dbx" is spelt in lower case probably because of its intended relation to the decibel and its abbreviation, dB.

Three modes of operation are possible with the dbx 119 dynamic range enhancer. When making tape or cassette recordings, it can be used as a compressor to reduce the dynamic range to manageable proportions. During playback of prerecorded tapes or discs it can be used as an expander to recover lost dynamic range. And finally by making tape recordings with the dbx 119 in the compressor mode and playing back with the same but complementary degree of expansion the dbx functions as a noise-reduction system with the advantage of no dynamic loss. It can even be used in conjuction with Dolby noise reduction to extract the maximum performance from a cassette or tape system.

While it may be thought that the 40 to 50dB signal-to-noise ratio available on most cassette and tape systems is more than adequate for most recorded material, in practice it is often not so. For a start, if the sounds to be recorded are those of a musical performance, the dynamic range can easily exceed 80dB.

Secondly, the signal-to-noise ratio of a system merely defines the difference (or ratio) between the maximum signal level and the residual noise. In practice, the available dynamic range able to be recorded on any medium is rather less than the signal-noise ratio. In the case of a tape system for example, if a recording is made below minus 30VU hiss becomes predominant while if the recording is above about minus 10VU, the high frequency response suffers.

So while it is possible to make very satisfactory recordings from disc to cassette for popular instrumental music, the greater dynamic range of most classical music clearly shows the shortcomings of cassette systems, even where Dolby is employed.

Many cassette decks attempt to mitigate this problem by automatic level control circuitry which acts to compress the signal once it exceeds a certain threshold (usually OVU) but this is only a partial answer, particularly in live music recording situations. In fact, it would appear that very few domestic tape or cassette machines are used for recording live music performances. Partly this is because of lack of opportunity and partly because the result is seldom really satisfactory.

Having painted a black picture for cassette machines in particular, it must be said that the dbx 119 represents a saviour. It enables a much greater dynamic range to be satisfactorily recorded. And played back. This would appear to be its major application.

As can be seen from the photographs, the dbx 119 has two control knobs, one slide switch and a LED indicator. The large knob could be termed the Slope control. When this control is set to 1.0 the unit neither compresses nor expands the signal, but merely produces a close replica of the input signal at its output terminals. Rotating the Slope control clockwise results in varying degrees of expansion up to 2.0. Rotating the Slope control anti-clockwise from 1.0 provides varying degrees of compression.

If, for example, the Slope control is set for an expansion of 1.2, this means that for every increase of input signal by 10dB the output signal increases by 12dB. A similar but reverse process occurs in the compression mode. At all times there is a fixed relationship between the input and the output signals, dbx term this "decilinear" operation.

To the left of the Slope control is a smaller knob which shifts the level at which unity gain is achieved. So while the first control changes the slope of the input/output characteristic, the threshold control shifts the whole characteristic up or down to suit the system it is being used with.

The slide switch functions as a Mode switch. In the linear position the unit functions as described above. In the "Above Threshold" mode, expansion or compression only occurs when the signal level exceeds the threshold which is now set by the threshold control. When used in this way in the compression mode, the unit functions in exactly the same way as the automatic level control found on many cassette decks, except the dbx has the added feature that the characteristic slope above the threshold can be altered.

When the signal level exceeds the threshold in the "above threshold" mode, the LED indicator flashes.

Overall dimensions of the dbx 119 are compact at 146 x 95 x 229mm (W x H x D) while mass is 2kg. Power consumption is minimal at 2 watts from the 240VAC mains.

Basically the circuit of the unit consists of two voltage-controlled amplifiers which vary the gain in both channels in response to a DC control voltage developed by a signal detector. The detector monitors the signal level in both channels to derive a common control

TURNTABLES EXPLAINED:

KP-1022**
Motor/Drive System: 4-pole synchronous motor-belt drive. Speeds: 33⅓ and 45 rpm. Wow and Flutter: Less than 0.07% WRMS. Cartridge: Moving magnet. Frequency Response: 20-20,000 Hz. Fitted with anti-skating device. Manual operation.

$139.00*

NEW FOR '76

KD-2033**
Motor/Drive System: 4-pole synchronous motor-belt drive. Speeds: 33⅓ and 45 rpm. Wow and Flutter: Less than 0.06% WRMS. Cartridge: Moving magnet. Frequency Response: 20-20,000 Hz. Fitted with anti-skating device. Auto cut, auto return.

$169.00*

NEW FOR '76

*Recommended Retail Price
**Averaged manufacturers' specifications subject to change without notice.

KD-3033**
Motor/Drive System: 4-pole synchronous motor (turntable) and 24-pole synchronous gear motor for auto operation—belt drive. Speeds: 33⅓ and 45 rpm. Wow and Flutter: Less than 0.06% WRMS. Cartridge: Moving magnet. Frequency Response: 20-20,000 Hz. Fitted with anti-skating device. Full automatic operation.

$219.00*

A turntable is the principal programme source of a hi-fi system and is made up of many intricate parts, one of which is the tone arm and when fitted with a stylus traces the modulation grooves of your record and sends the ensuing signal to your amplifier. The turntables above are examples of good turntables. They aren't cheap, but nor is any good hi-fi component. Their specifications and features are their credentials. If you understand them, you'll know just how good they are. If you're a bit lost with the specifications, we have just the thing: "The New, Improved, Updated, More Detailed Hi-Fi Explained in Simple Language by Kenwood Booklet". It will make these specifications much clearer. Because when you know more about good hi-fi, you'll be better able to appreciate Kenwood hi-fi.

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signal.

In normal use as an expander, the dbx 119 is interposed in the amplifier chain by connecting it to the tape monitor terminals and depressing the tape monitor switch. When it is used for making tape or cassette recordings, the tape machine line inputs are connected to the line outputs of the dbx while the replay outputs of the tape machine are connected to the auxiliary inputs of the amplifier.

Construction of the dbx 119 is quite simple. Aluminium extrusions are used for the front and rear panels and slots in these retain the vinyl-coated aluminium top and bottom panels. The side panels are oiled timber. Inside there is a PC board occupying the full depth and width and accommodating relatively few components.

Aside from the power supply, six transistors in the voltage regulator circuits and five operational amplifier integrated circuits, there are three large metal-encapsulated circuits. These apparently contain a mixture of active and passive components for the two voltage controlled amplifiers and the signal detector.

Although the literature describes the detector as an "RMS detector" we have doubts whether it really does give a "true RMS" output since to do so involves measurement of the heat-producing effect of a signal. It requires the use of thermistors or other heat-sensitive device in a balanced bridge circuit. Consequently, attack times can be limited. In fact, the instruction manual for the similar model 117 gives the game away by referring to C12 in the circuit as "the RMS averaging capacitor". In the same paragraph there is a reference to a resistor which "controls the relationship between negative and positive signal level sensing". Thus there is some reason for doubt whether the detector module gives an RMS output.

In any case it seems unimportant to us that the detector should give an RMS result; just why this would be needed is certainly not explained.

(Note: At the time of writing this review there was no instruction manual for the model 119. In its stead, a 117 manual plus a supplement for the 119 was supplied.)

Time did not permit us to make all the measurements and tests we would normally like to perform with this unit. We had to content ourselves with a number of listening sessions in varied domestic conditions.

When used according to the instructions, the dbx can provide very worthwhile gains in dynamic range and signal-to-noise ratio in conjunction with cassette recorders. It can also give a modest improvement in dynamic range when listening to disc recordings and at the same time give an apparent improvement in signal-to-noise ratio.

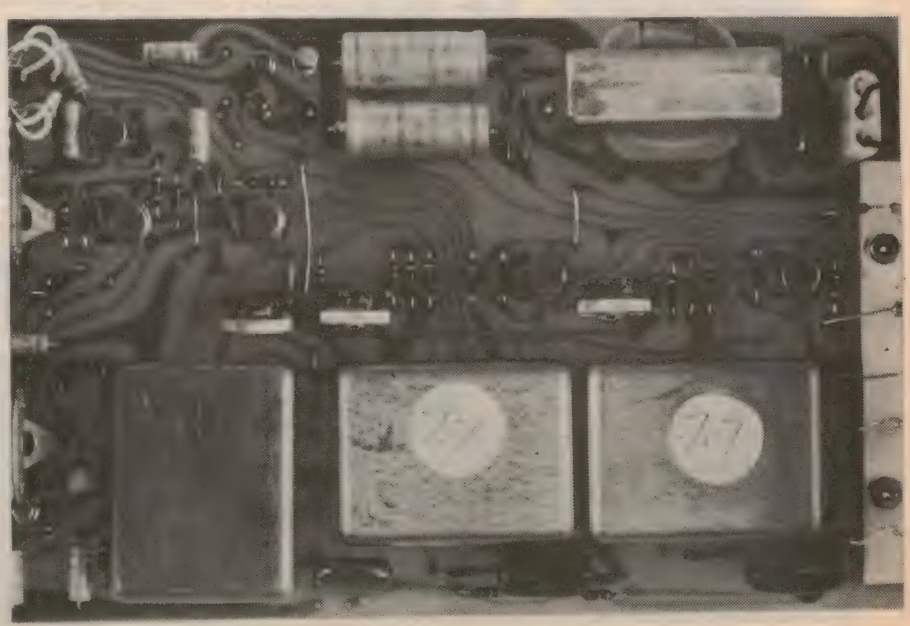
This happens because the effect of an expander is to increase the peak-to-average ratio of the program. So the average listening level is reduced slightly and the peak level is increased slightly, according to the degree of expansion used. Since the average listening level is reduced, so too are noise effects such as rumble, surface noise and "pre-echo" at the beginning of each track. The overall effect is not spectacular but is quite worthwhile. If used correctly, the unit is set and forgotten—as are tone controls and most other features on amplifiers.

If excessive expansion is used, the reproduction becomes unnatural as the music surges or "pumps" and the unit produces "breathing" effects.

To sum up, the dbx 119 or its less expensive version, the 117, can add a worthwhile improvement in dynamic range to any system. It should sell well since it has the market to itself. The catch is that it is expensive, especially regarding the relatively modest circuitry it entails. Recommended retail price of the dbx 119 is $239, while the 117 is $199.

Further information and demonstration can be obtained from hifi retailers or from the Australian distributors for dbx, Auriema (Australasia) Pty Ltd, 15 Orchard Road, Brookvale, NSW 2100. (L.D.S.)

Above is the rear view of the dbx 119 while below is the PC board.



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$75 TAX INCLUDED

6Channel capacity, 27.880 fitted large 2 - 1/4" P.D. speaker, squelch control and RF power meter. Also external speaker, power, mike, antenna and earphone jacks. Power from 10 penlight batteries or rechargeable Ni–Cd batteries. Comes in handsome, easy–to–hold, weatherproof cabinet with 50" whip antenna.

SPECIFICATIONS

Receiver	
Receiving system	Crystal-controlled superheterodyne
Sensitivity	0.5μV at 10 dB S/N
Squelch sensitivity	0.3μV
Transmitter	
Modulation	100% (with over modulation limiter)
RF input power	5W
General	
Semiconductors	12 transistors, 2 IC, 18 diodes
Frequency control	Crystal
Channels	6 channels (1 ch. crystal supplied)
Speaker	2–1/4" (dia.) 8 ohms, mylar cone
Weight	1.4 kg
Dimensions	75 x 280 x 87 mm

All-Weather 1W 2-Channel Handy Type Transceiver TA 303A

$49 TAX INCLUDED

Easy to use ; easy to own. A handy, all weather model. Ideal for construction sites, camping, other outdoor activities. Power is from 8 tiny penlight batteries or through a plug–in power source socket. Comes in an attractive, lightweight cabinet with controls on top and a telescopic whip antenna. Complete with battery indicator, self–contained mike, squelch control and earphone jack.

SPECIFICATIONS

Receiver	
Receiving system	Crystal-controlled superheterodyne
Sensitivity	0.7μV
Squelch sensitivity	0.5μV
Transmitter	
Modulation	100% (with over modulation limiter)
RF input power	1W
General	
Semiconductors	11 transistors, 1 IC, 8 diodes
Frequency control	Crystal
Channels	2 channels (1 channel fitted)
Connectors	Earphone jack
Speaker	2–7/8", 8 ohms, permanent dynamic speaker
Dimensions	50 x 250 x 76 mm
Weight	680g

All-Weather 1Channel Transceiver with 300mW Power, Squelch Control TA 222A

A simplified model with performance–proven circuitry and a rugged, all weather cabinet. Comes fully equipped with battery condition indicator, squelch control, earphone jack and is powered from 8 penlight batteries. Equipped with sensitive superheterodyne receiver and PI network for optimum RF output.

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SPECIFICATIONS

Receiver	
Receiving system	Crystal-controlled superheterodyne
Sensitivity	0.7μV
Squelch sensitivity	0.5μV
Transmitter	
Modulation	100% capability
RF input power	300mW
General	
Semiconductors	10 transistors, 1 IC, 7 diodes
Frequency control	± 800Hz
Channels	1 channel – 27.24 MHz
Speaker	2–7/8", 8 ohms, permanent dynamic speaker
Dimensions	50 x 250 x 76 mm
Weight	640g

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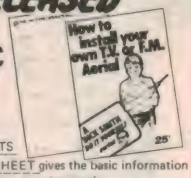

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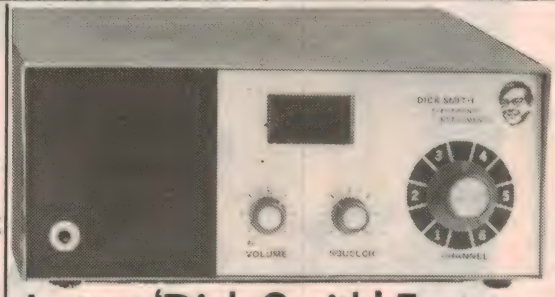

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SPECIFICATIONS 15 transistors,15 diodes : 6 channel capacity : 50ohm antenna : 12 to 16V nominal power supply or 240V ac : 500-2000ohm mic impedance : 8ohm speaker : 1uV receiver sensitivity Selectivity 50db down at 10kHz : Automatic Noise Limiter : 1.5W audio output : 455kHz IF : Power consumption Rx 200mA @ 13.8V;TX 900mA without mod.: Transmitter output 5W Frequency tolerance 0.005% : Signal strength and power meter : Mic has in built matching transformer.

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A guide to Amateur Radio is intended to assist newcomers to learn more about the hobby, and to help him or her to obtain an Amateur licence.
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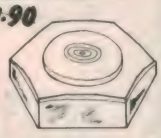

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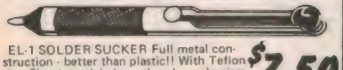

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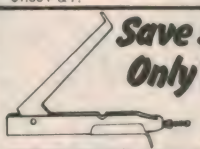

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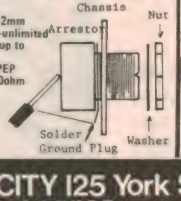

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20W per channel amplifier from Dick Smith

Stereo amplifiers with a power rating of about 20 watts per channel are very popular on the Australian market. Recognising this fact, Dick Smith Electronics has available just such an amplifier at the favourable price of $129.

We just have to comment on the most noticeable feature of this amplifier. That large "Dick Smith" logo on the front panel is so obstrusive that it must reduce the attractiveness of what is otherwise a worthwhile unit.

Six knobs and five switches are spread out over the front panel to produce a satisfying but uncomplicated array. All the usual controls are featured plus two microphone sockets. The loudspeaker switching is a little unusual in that it is accomplished with a toggle and a rotary switch. The toggle switches the output between the single pair of loudspeakers and the stereo headphone socket, while the rotary switch provides normal or reverse stereo connection of the loudspeakers.

On the rear panel a bank of RCA sockets provides for connection of a magnetic cartridge, one high level source (AUX) and a tape or cassette deck which is brought into play by depressing the tape monitor switch. The tape monitor inputs are also parallelled by a five pin DIN socket. Two fuses are provided for overload protection.

Loudspeaker connections are made to a screw terminal strip which will accept spade lugs or bare wires. One problem with this terminal strip is that the connections are not labelled in any way. We did find, that the connections are logical with the centre terminals the two earth while the outer two were the two active connections.

Two 2-pin mains outlet sockets are provided for connection of other equipment. We have commented on the undesirability of these sockets in the past so will not belabour the matter. However, the amplifier itself is also fitted with a two-core mains cord and two-pin plug which is definitely non-approved. These cords really should be changed to the approved three-core type with three-pin plug before being sold to the public. At the very least, the two-pin plug should be removed and a three-pin plug supplied in its place.

Removing the black crackle-enamelled cover reveals a spacious chassis with four PC boards accommodating the circuitry. While the layout is reasonably uncluttered, service accessibility is only fair as the two preamplifier board would require partial disassembly of the amplifier for any repairs. Fortunately, most solid-state equipment is very reliable.

One good point though, all the circuit components are readily available if repairs should ever be necessary. For example, the output transistors are 2N3055's, a point which should please many because of their reputation for ruggedness.

We did not have access to an instruction manual or circuit diagram at the time of writing this review so cannot comment in detail on the circuitry. The power amplifiers certainly appear to be conventional with the output stages in quasi-complementary mode as might have been gathered from the above comments. The supply rail is a nominal 60 volts DC and the output is coupled to the loudspeakers via 1000uF electrolytic capacitors.

The output transistors are mounted on aluminium heatsinks within the amplifier so the unit should be kept well ventilated.

During initial listening tests we had the impression that the tone controls gave an unnecessarily large amount of boost and cut and also their effect on the midrange frequencies appeared more than desirable. In other respects the unit gives a good impression, with all controls operating smoothly and quietly.

Instrument testing revealed potentially good results. Power output into 8-ohm loads was 20 watts RMS with both channels and 26 watts RMS with one channel driven. With 4-ohm loads, the corresponding figures were 22 watts and 25 watts. One point though, continuous testing at full power into 4-ohm loads presents the danger of burning out the miniscule emitter resistors in the output stages. Of course this risk does not occur with normal music signals.

Distortion at full power into 8 ohms at 1kHz was 0.1%. At lower powers the result was typically 0.2%. At either end of the audio spectrum distortion rose but at no time did it measure in excess of 1% total harmonic distortion. Frequency response with the tone controls adjusted for optimum results was 15Hz to 25kHz between the minus 1dB points, while separation between channels ranged from 42dB at 100Hz to 36dB at 10kHz.

Signal to noise ratio for the auxiliary input was particularly good at 80dB unweighted and with open-circuit input. For the phono input, one channel gave a figure of 72dB referred to 10mV at 1kHz and with short-circuit input, but the other channel gave a result 10dB worse and appeared to be faulty. Phono sensitivity was 2.5mV at 1kHz while overload capability at the same frequency was 150mV which is more than adequate.

The only problems in performance we discovered concern stability and the tone controls. We were able to produce an unstable condition with 0.33uF shunting an 8-ohm resistive load, so this unit could encounter problems with some loudspeakers. We found the major part of the boost and cut range of the tone controls was concentrated in the range 30 degrees either side of the centre setting. Not only does this make the control seem too sensitive but it makes it difficult to set the controls for a flat response.

In other respects, the amplifier performs well and sounds well. Apart from our reservations on some aspects of its presentation, particularly the mains cord, the amplifier would appear to be good value for money.

Further information and demonstration of the amplifier can be obtained from Dick Smith Electronics branches. (L.D.S.)

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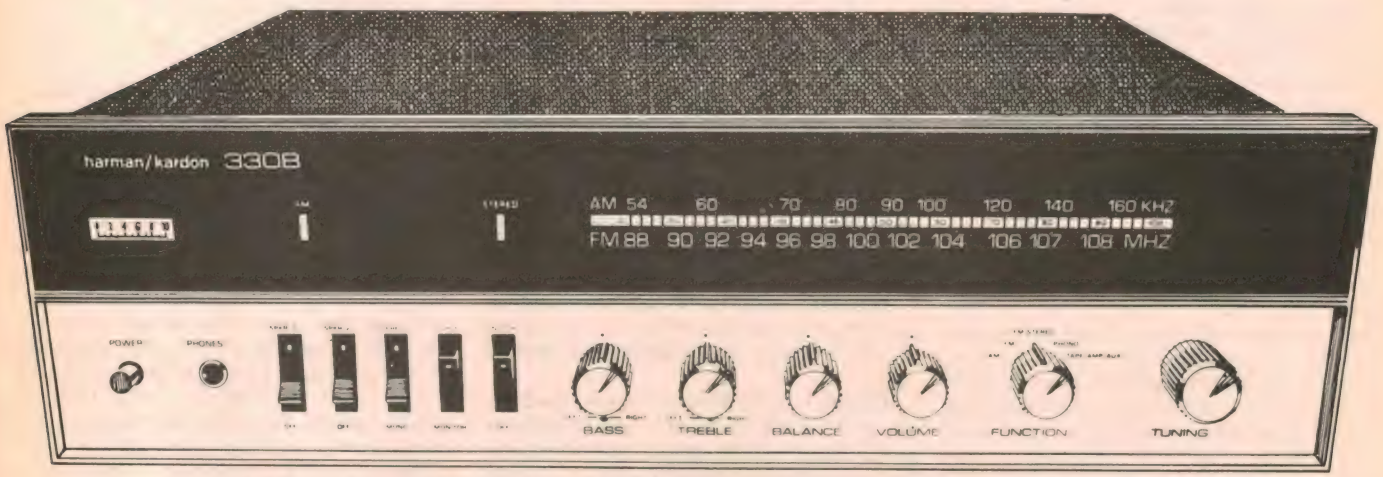
Start with the 330B. The only thing that keeps it out of the higher priced category is the price.



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** Recommended retail price*

Harman Kardon HK2000 Stereo Cassette Deck

Relatively few stereo cassette recorders are available in Australia from the USA. One of these is the Harman Kardon HK2000 which now supersedes the well-known HK1000. The HK2000 has many worthwhile features, yet also has a clean uncomplicated appearance.

Like many products with a US brand name, the Harman Kardon HK2000 is actually manufactured in Japan but we assume that it was designed in America.

Appearance of the HK2000 is quite different from the majority of cassette recorders now on the market. For example, the case is mostly metal, no timber being used. And it goes against the latest trend to produce front-loading machines. It also uses slide controls, which have been discarded on many other competitive brands.

For many people though, a top-loading machine is more convenient particularly as some front-loading machines are quite tricky to load and unload. Slide controls are perhaps also more appropriate to a top loading machine even though they can be a problem due to the ingress of dust and dirt to the resistance element. These are factors which must be considered when purchasing a machine.

Dimensions of the HK2000 are 381 x 260 x 136mm (W x H x D) and mass is 7.3kg.

Seven push-buttons control the transport mechanism which has automatic stop at end of tape and memory rewind. Two 6.5mm jack sockets are provided for low impedance microphones, and these are level-controlled by two small knobs adjacent. Slider controls are used for the record and playback levels. The playback level controls also effect the level fed to the stereo headphone socket.

The slider controls have 60mm travel and particularly smooth and pleasant to use. They are almost ideal for this level control application. In fact we wonder why they were not also used for the microphone recording level controls.

There are four toggle switches for the following features: Multiplex filter, tape (low noise or Cr02), memory rewind and Dolby noise reduction. The multiplex filter is switched in when making recordings of FM broadcasts and has circuitry to remove residual 19kHz and 38kHz signals from this program material.

For optimum performance from Cr02 tape, quite a few circuit parameters must be changed from the normal low noise tape settings. Bias and erase levels are increased, recording and playback equalisation is changed as are signal levels to the recording head and the sensitivity of the metering circuitry. All of this is accomplished by the tape toggle which operates a multipole slide switch on one of the PC boards inside the machine. Many decks with a Cr02 switch dispense with these refinements, so the HK2000 gets the nod of approval here.

As well as the normal Dolby noise reduction facilities there is is an inbuilt oscillator to provide correct Dolby reference levels for record and playback. Screwdriver presets are provided adjacent to the level meters for these adjustments.

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HARMAN KARDON HK2000

The highly legible meters are commendable in that they provide an indication of signal peaks instead of average levels as is normally the case. The response times of the meters are such that they are very effective in showing peak signal levels. As well, there is a LED indicator which flashes to show signal peaks too fast for the meters to follow. The indicator lights for signals greater than about plus 2.5dB above OVU.

On the rear panel there are three pairs of RCA sockets for input and output connections. There is also a slide switch which provides a subsonic filter to remove rumble or other low frequency effects from the signal during recording. The filter has a normal rolloff at 20Hz and 6dB/octave below that. One other feature is a screw-driver preset for the motor speed. The manual advises the owner not to touch this unless he has the necessary equipment to check tape speed.

Once again, this machine is one of all too many on the Australian market fitted with a two-core flex and two-pin mains plug. The two-pin plug is definitely non-approved and so also is the two-core flex since this is not a double-insulated appliance. Indeed it is probably only a matter of time before the relevant electricity supply authorities make moves to ban the sale of what is patently unsafe equipment. This statement may be devalued by many readers but if the transformer or wiring insulation breaks down the chassis will be "live" at 240VAC and lethal. Make no mistake, this is just the sort of situation which can and does kill people every year in Australia.

For their own sake and reputation, the Australian distributors should make it their business to have the cassette decks fitted with the correct three-core mains cord and three-pin plug. After all, this is by no means an inexpensive appliance.

Removing the case of the machine reveals a closely packed interior with the PC boards accommodating what appears to be myriads of components. A single DC motor drives the transport mechanism via variety of pulleys and belts and a large solenoid stops the transport for the automatic stop and memory rewind functions.

Frequency response on low noise tape was within the specification of 40Hz to 12.5kHz within plus or minus 2dB. For chromium dioxide tape, the response was better and again within the specification at 30Hz to 15kHz within plus or minus 2dB. Thus the HK2000 is one of the few machines we have tested which have met their specification for frequency response. With Dolby noise reduction switched in there was a slight degradation in high frequency response and the curve was a little more irregular, but not seriously so.

Signal to noise ratios were specified at 48dB with Dolby out and 53dB with Dolby in. This specification is a little unusual in itself in that it is an unweighted measurement. We measured results of 50dB without Dolby and 54dB with Dolby. Again these are very commendable results.

Total harmonic distortion is quoted at less than 1.5% at 1kHz at 2dB below OVU. We were able to verify this and achieved a reading of less than 2% at OVU which means that the manufacturer has not pushed distortion levels to the limit in order to achieve a good signal-to-noise ratio.

Wow and flutter is specified at 0.07% or less which we presume is an RMS rating. We measured wow and flutter at less than 0.2% (DIN) but this varies to quite a degree depending on the cassette in use. In fact it can and does vary quite markedly within the length of a tape.

Rewind time for a C60 cassette was of the order of 75 seconds. The delay between end of tape and automatic shut-off was shorter than is usually the case, at about two seconds.

While the meters are commendable in their easy legibility, their calibrations do not mean a great deal. For example, if the recording level is set to OVU and then reduced by 10dB, the reading of the meters was minus 7dB. Again, an increase in signal of 3dB above OVU gave an indication of about 1.7dB. In practice, the inaccuracy of calibrations may not be so important but one expects more accuracy in this price range.

Frequency response of the metering circuitry was good by comparison and was only 1dB down at 15kHz.

Having performed all the measurements we made a number of recordings from high quality discs and then compared with the discs and on playback with several other Dolby cassette decks we had access to at the time. In these listening tests the Harman Kardon HK2000 was noticeably to the fore. It clearly outperformed the other machines in sound quality although admittedly it was the most expensive of those in the comparison.

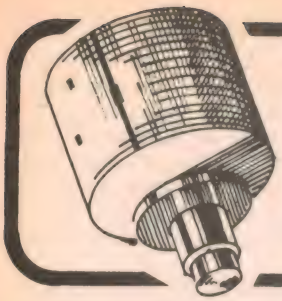
When compared to the disc originals there is no doubt that many people would find the cassette copies virtually indistinguishable from the originals. Where the differences were noticeable were predictable: on the quiet passages, where hiss became noticeable when the amplifier volume was advanced and on the loud passages where the high frequency response deteriorates.

One point we did find annoying was the noticeable wow at the beginning of tape replay where the Play button was depressed. This may have been due to maladjustment but it is the first time we have experienced this type of fault.

Summing up, we must rate the HK2000 as an expensive machine. It has very good performance and is all the more creditable because it meets the specifications. Its sound quality is particularly good, among cassette decks. The major criticism is the lack of correct mains cord and plug.

Recommended retail price of the HK2000 is $568 including sales tax. Accessories included in the purchase price comprise the instruction manual and adaptor leads fitted with DIN to RCA type and RCA to RCA.

Further information on the HK2000 and other Harman Kardon equipment can be obtained from hifi retailers or the Australian distributors Harmon Australia Pty Ltd, 271 Harbord Road, Brookvale, or postal address, PO Box 6, Brookvale, NSW 2100. (L.D.S.)



News Highlights

New machine will aid cot death research

A machine which gives a breath-by-breath analysis of the breathing of young babies will help a Sydney research team in their investigations into the mysterious cot-death syndrome.

Cot-deaths—the unexplained death of an apparently normal baby—have long baffled doctors and scientists. A research team at Sydney's King George V Hospital is now making a full-time study of cot-deaths, with a program that may extend up to five years.

The new machine, designed to analyse the gases entering and leaving the lungs of babies, is the most advanced of its kind in the world. The electronics for the machine were designed by Dr Peter Nickolls, a Research Fellow in the Department of Electrical Engineering at Sydney University, and it was built by Amalgamated Wireless (Australasia) Limited in little over a month.

A recent American review concluded that cot-deaths are the leading cause of death among infants between one week and one year of age. Cot-deaths claimed 124 babies in NSW alone last year; in America the total was nearly 10,000.

Dr Bruce Storey, the staff specialist in the newborn intensive care nursery at King George V Hospital, says that an equally important problem is the breath-holding spells of premature babies.

Doctors have found that when very premature babies fall into a certain sleep phase they literally "forget to breathe". Their oxygen supply becomes dangerously low and if this is allowed to continue they can die or suffer brain damage.

In the late 1940's and 1950's oxygen was widely administered in these circumstances, but a secondary problem arose. It was found that too much oxygen could damage the retina of the eyes and cause blindness.

The leader of the research team, Professor David Read, Associate Professor of Physiology at Sydney University, describes the balance between too much and too little oxygen as "a knife edge situation".

It is therefore crucial, he says, to be able to follow the oxygen and carbon dioxide levels in a baby's breathing and to regulate them carefully.

It is in this area that the new machine will be a valuable aid for both research and treatment. Other machines cannot follow the breath-by-breath changes in the gases entering and leaving the lungs and are not designed to process the small breath samples provided by a tiny baby.

In the new machine, the baby's breath flows from a connection at its nose into a vacuum chamber where it is ionised and separated into its constituents. A processor then works out the percentage of oxygen and carbon dioxide in the breath. It can also simultaneously follow another six gases to provide additional information about the circulation and the function of different regions of the lungs. All this information is processed at 25 times a second.

Ultimately, it is planned to link the machine to an automatic, computer-controlled system which will adjust the baby's oxygen supply as its breathing changes. This is a three-year project for Dr Nickolls.

Australian breakthrough in solar panel absorber coating

From left to right: Dr Jones, Dr Smith, Dr Riddiford, and engineer Peter Shepard (kneeling) at work on the prototype.

Details of an exciting high-temperature solar absorbing surface were given at a recent Solar Power Symposium at the Australian National University by a team of scientists from the NSW Institute of Technology, Sydney. The new surface, known as chrome-black, was developed by co-workers Dr Chester Riddiford, Dr Bob Jones, and M.Sc student Philip Driver.

A prototype solar absorber unit employing the new solar coating was recently demonstrated in Sydney. The prototype consists of a long, chrome-black coated copper strip running inside an evacuated glass tube about 10cm in diameter and 2 metres in length. Copper tubes running down the underside of the copper strip are used to recirculate water. This type of absorber construction has recently come into prominence in the USA.

The advantages of this system are that heat losses are minimised, as in a thermos flask, and higher temperatures are attainable. It is for these reasons that the new solar absorber surface is considered such an important breakthrough, having as it has a much greater resistance to high temperature breakdown than existing absorber coatings. Significant, too, is the fact that the new surface is prepared by a cheap electrochemical process.

Drs Riddiford and Jones were on hand to demonstrate the prototype system, together with theoretical physicist Dr

(Continued opposite)

New solar panel coating

Geoff Smith and engineer Peter Shephard who built the prototype. In the demonstration, water was rapidly recirculated through the absorber by an electric pump and back to a 44 gallon drum which served as a reservoir. The water in the three-quarters full drum was hot, almost too hot to touch—and this from a single absorber on a somewhat hazy, if otherwise clear, summer afternoon in Sydney.

The prototype absorber is capable of producing steam in small quantities, although an array of such "fluorescent tube" type absorbers would be required in a practical application. For example, one proposal for a large scale solar powered refrigerator would require an absorber array covering 90 square metres to produce 36,000BTUh (10.5kW) of cooling power. This would involve some 160 single absorber units.

Nevertheless, Dr Riddiford and his colleagues are confident that this type of high efficiency solar absorber could be of considerable industrial importance for steam generation at 150°C. It is not yet known how competitive in terms of cost the new system would be compared with conventional flat plate absorbers for domestic purposes.

Software course for microprocessors

Creative Strategies Pty Ltd in conjunction with Motorola Australia Pty Ltd, is conducting software courses for Motorola 6800 microprocessor users and potential users.

Microprocessors are gaining popularity with systems designers by allowing more flexibility, economy and power than conventional hard wired systems configurations. By far the most significant type is the 8-bit microprocessor, this representing a balance between power and simplicity.

The use of microprocessors, however, demands new skills of the engineer in order to solve problems quickly and economically.

The one-week courses are designed to remove a substantial portion of the "learning curve" associated with the use of microprocessors. The courses deal mainly with programming, the most expensive aspect of microprocessor use, and the area where potential microprocessor users cannot spend large amounts of time and money just learning how to define problems.

Each course will consist of 35 hours study, and will be limited to a maximum of 17 students to assure a maximum of individual attention. Course venues are in Sydney and Melbourne. Further information is available from Motorola Australia Pty Ltd, 37-43 Alexander St, Crows Nest, NSW 2065.

British pacemaker responds to body's needs

Medical research workers at Sussex University near Brighton, southern England, have developed and successfully tested a new kind of heart pacemaker which obeys the needs of the human body and heart, rather than dictating to them.

The normal pacemaker used to restore rhythmic beating to a disturbed or damaged heart works by feeding regular pulses of electricity into a pair of electrodes in one of the ventricles, the muscular chambers which pump blood around the body and through the lungs. This pacemaking cannot adjust to the body's varying needs in the flexible way in which the intact heart can. Nor is a ventricle driven in this way able to beat perfectly in time with its atrium.

The atrium is a small chamber on top of each ventricle and is responsible for filling up the ventricle just before each of the ventricle's pumping strokes. The atrial beat occurs a fraction of a second before that of a ventricle and varies according to the body's needs. This means that it can beat out of phase with a ventricle driven by a rigorous pacemaker, leading to reduced pumping efficiency.

The Sussex pacemaker overcomes this problem by taking its timing from the atrium. Small electrodes placed in the atrium produce an electrical signal when the atrium contracts. This signal is then delayed by the appropriate time and amplified to provide a stimulating pulse to one of the ventricles.

. . . and at Harwell, a new nuclear pacemaker

A nuclear 'Long-Life' heart pacemaker has been developed by British nuclear scientists and successfully tested by leading British heart specialists.

Initial tests, involving the planting of nuclear pacemakers first in animals and, over the past five years, in humans, have established that the nuclear pacemaker is safe, highly efficient and has an implanted lifetime of ten, and quite possibly 20 years. This compares with a lifetime of about three years for existing pacemakers powered by chemical batteries.

Production orders for 300 of the new nuclear pacemakers have been announced by Britain's Department of Health and Social Security (DHSS), which supervised exhaustive tests of the prototype models. The work has been contracted to the Harwell Atomic Energy Research Establishment where the batteries for the nuclear pacemaker were developed. The pacemaker was designed by the Implant Division, Devices Ltd, Welwyn Garden City, southern England.

The batteries, using Isotope Plutonium 238, have been stringently tested to internationally agreed safety standards for nuclear materials. This means that the nuclear pacemakers have no radiation hazard and can withstand the most severe accident that they are ever likely to encounter.

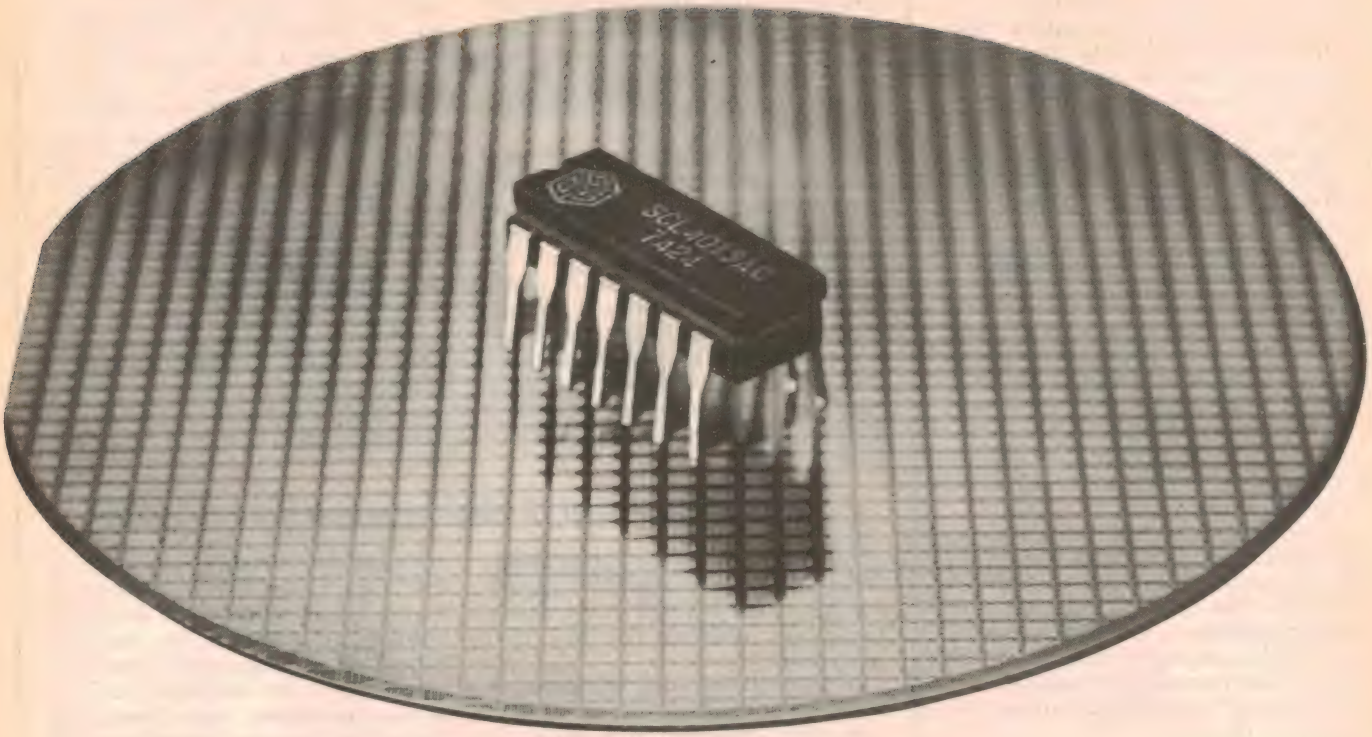
Choosing the right calculator at DSE

Do you know what Reverse Polish Notation is? Could you tell the difference between a Live percentage key and, presumably, a dead one? What's an Accumulating Memory?

Already, the pocket and desk top calculator has surrounded itself with a host of technical terms which frighten, or at least bewilder, the average person. With so many machines and so much "mumbo-jumbo" associated with them, Dick Smith decided that it was time for someone to dissolve some of the mystery and help people choose the right calculator for their particular requirements.

As a result, Dick has opened a specialist calculator department at his Gore Hill Sydney electronics store. In charge of the "Calculator Centre" is engineering graduate Stephen Bundred. He's on hand to advise and demonstrate calculators ranging from "shopping" models at around $6 right through to advanced scientific machines costing over $1,000.

According to Dick Smith, every calculator on display has been individually chosen to meet a particular need at the best price. The new service will ensure that the purchaser buys the right calculator at the right price and will be able to derive the full benefits from the functions offered.



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NEWS HIGHLIGHTS

Australian launch for British Skylark rocket

A 'Skylark' rocket payload towers above equipment in the British Aircraft Corporation's research rocket preparation centre in south-west England. The payload is 5 metres in length and when connected to the rocket motors will measure 13 metres, the longest Skylark ever launched.

The payload is a joint venture between the Mullard Space Science Laboratory and NASA. Its main feature is an X-ray telescope which will be used to produce an energy level map of X-radiation emitted by a supernova remnant which astronomers think may have at its centre a neutron star or pulsar. (A supernova is an extremely rare exploding star whose brightness may increase many thousands of times during the explosion, releasing vast quantities of radiation and a gas cloud which expands at over ten million kilometres per hour.)

As well as the telescope, the payload contains standard instrumentation to assess the rocket's in-flight performance and to return scientific and technical data to earth using the on-board telemetry system which was developed by Mullard in conjunction with the University of Birmingham.

Due for launch in April, 1976, the rocket will be the 250th to be flown from the Woomera range in Australia. It will lift the payload to a height of 260kms.

Rubbish recycling ready to go commercial

Automated rubbish sorting lines, which sort ordinary domestic refuse into different categories ready for recycling, are now a real commercial proposition. Britain's Warren Spring Laboratory, acting as consultants to an engineering firm where a full-scale sorting line has now been working for a year, are now ready to build a plant able to sort 200 tons of rubbish every 24 hours.

The income from the metals, paper and industrial fuels extracted from the rubbish could easily exceed cost of sorting rather than tipping rubbish, especially as tipping sites are becoming scarcer and scarcer, whereas sorting lines can be built almost anywhere. So rubbish sorting for recycling is now a commercial proposition.

Surprisingly, the breakthrough has come, not by promoting the more obviously useful elements in rubbish, like tin cans, bottles and clean newspaper, but in the humble shape of low grade, dirty, mixed paper waste. This, in the elaborate Warren Spring sorting plant, comes out of a different channel from high-grade newsprint.

Simply pushing the low-grade paper waste through an extruding machine produces a hard, round cylinder, a convenient fuel with a calorific value (heat-producing ability) more than half that of coal. The product is an excellent fuel for several industrial purposes, including power station use.

The Warren Spring team based at Stevenage, Hertfordshire (southern England), have no doubt that the fuel can be sold in most industrial areas, especially near power stations, thus tipping the balance of costs involved in building a commercial sorting line over towards profitability.

Appliance makers aim for increased efficiency

. . . the goal is a 20% reduction in energy consumption

Fifty-seven major US appliance manufacturers have agreed to support a voluntary program aimed at achieveing a 20 percent average reduction in the energy consumption of new household appliances by 1980. This was announced recently by the US Assistant Secretary of Commerce, Dr Betsy Ancker-Johnson.

The firms involved account for 93 percent of the retail sales of the appliances covered in the Commerce Department's Voluntary Program for Appliance Efficiency.

The Assistant Secretary said that the 57 companies supporting the program represent all categories of appliances for which energy efficiency goals are being set. Electric appliances in the program are room air conditioners, refrigerators, combination refrigerator-freezers, freezers, clothes washers, dishwashers, and television receivers (black and white as well as colour). Appliances that use either gas or electricity are water heaters, clothes dryers, and kitchen ranges.

The Voluntary Program for Appliance Efficiency was established by President Ford in a supplement to his State of the Union Message, January 15, 1975. President Ford called for a 20 percent average reduction in energy consumption of all major appliances by 1980, and for agreements by major appliance manufacturers to comply with the goals. If agreement could not be obtained in six months, President Ford said he would request legislation to establish mandatory appliance efficiency standards.

It is estimated that achievement of the efficiency goals set will result in savings equivalent to one-half million barrels of oil per day by 1985.

Dr. J. S. Ratcliffe new president of IREE

Dr. J. S. Ratcliffe

Dr. J. S. Ratcliffe, Professor of Chemical Engineering at the University of New South Wales, has been elected President of the Institution of Radio and Electronics Engineers Australia.

A member of the Institute for more than 25 years, Professor Ratcliffe was a member of the Newcastle Division from 1948 to 1965, when he joined the Sydney Division. He was Deputy President of the Institution from 1974 until his recent election.

Professor Ratcliffe gained his M.Sc in 1957 and his Ph.D degree in 1961 from the University of New South Wales. As well as his association with the IREE, he is a member of two other professional engineering institutions. In addition, he is a member of the Technical Advisory Committee of the NSW State Pollution Control Commission, and is on the National Coal Research Advisory Committee of the Federal Department of Minerals and Energy.

NEWS HIGHLIGHTS

Opening night at *SONY HOUSE*, Sydney

EA Editor-in-Chief Neville Williams (left) greets Mr Susumu Yoshida, Senior Managing Director of Sony Corporation, Tokyo, during the recent opening of SONY House at 453-463 Kent St, Sydney. Standing next to Mr Yoshida (who was responsible for the development of the Trinitron colour TV tube) is Mr P. H. W. Jacoby, Chairman of SONY Kemtron Pty Ltd. The fourth member of the group is Mr Tomio Maehara, Director of SONY Kemtron Pty Ltd.

Low-cost automatic pilot for small boats

A joint-winner of the last John Lysaght Inventor's Award is now manufacturing his invention and marketing it in Australia and overseas. The invention is an automatic pilot for small boats, and the inventor is Mr Richard Chapman, an electronics engineer and a yachting enthusiast.

Mr Chapman shared the $5,000 1974 Lysaght Inventor's Award with nine other inventors around Australia. The Coursemaster 100, as he calls his automatic pilot, has a patented course memory, an integrating computer amplifier, and a steering aid facility. Easy to operate, it automatically provides: prompt and infallible course acquisition; course memory with 360° control; computerised yaw stabilisation; rudder sensing and rudder trim; and local or remote steering aid information.

The pilot is a quite ingenious device in which light-sensing cells are set opposite each other over a magnetic compass card into which has been cut a crescent-shaped slot. Light shines from beneath the compass through the crescent-shaped aperture to place an equal charge on each cell when the boat is on course.

Should the boat diverge from course, the amount of light reaching each of the

two cells is unequal and hence their charge is unequal. This activates the steering mechanism to bring the boat back on course. A third cell is also placed above the compass card, and when the boat is on course has no light on it. This cell, combined with the others, activates the memory circuit to ensure that the pilot always steers the boat to any new course by the shortest arc.

Mr Chapman said the properties which set his pilot apart from others were its ability to acquire course immediately from a dial setting, low demands on power and steering equipment, and low price. Mr Chapman added that the instrument should sell at less than $1,000 to the boat owner.

AWA wins export award for navigational aids

Amalgamated Wireless (Australasia) Ltd has won the 1975 NSW Exporter of the Year Award. The award, initiated by the Export Development Group of NSW, is designed to assist the Australian Government's efforts to stimulate exports.

AWA won the award for supplying and installing $650,000 worth of radio navigational equipment at two sites in Nepal. One of these sites was at Kathmandu Airport, the other at Pokhara Airport. Each installation included Doppler VOR beacons which were designed and manufactured at AWA's Ryde factory in Sydney.

The contract awarded to AWA was secured in the face of strong international competition. As well as supplying its own products, AWA was required to commission equipment manufactured by other companies, and to take responsibility for the construction of buildings, emergency power supplies, fuel systems, and staff training.

Changes at McMurdo

McMurdo (Australia) Pty Ltd has advised that the company has now changed name to Swan Electronics Pty Ltd, effective as from January 1st, 1976. The company has also moved to a new address at Cnr Forster and Hardner Rds, Mt Waverley, Vic 3149. Telephone 544 3033.

..and at Weston Electronics

Weston Electronics, a member company of Kemtron Ltd, has changed address to The Crescent, Kingsgrove, NSW 2208. Telephone 50 0111.

Community radio station needs volunteer techs

A new community radio station, owned by the Community Radio Federation (CRF), is to commence operation in Melbourne. CRF was recently granted a 5 year AM licence by the Australian Broadcasting Control Board to operate the station.

CRF is a federation of nearly 80 diverse community groups. These include resident action groups, education groups, music groups, and ethnic minority groups. The aim of the society is to give a voice to groups and individuals previously denied effective access to radio.

At present, CRF desparately needs a number of skilled electronics technicians to work on a voluntary basis. These people are required to help build and modify recording, monitoring and transmitting equipment, and to repair and maintain existing equipment.

Anyone able to offer technical assistance to CRF is asked to contact the CRF studio, 1112 (rear) High St, Armadale, Melbourne, Vic 3143. Telephone 509 3160.

"Man coupled with computer will outlast man without computer"

YOU, COMPUTERS

Mention the potential of computer technology and you generate controversy—controversy on man's future. Are computers a blessing or a curse? Do they hold the key to a better lifestyle or do they represent potential Orwellian hell? This article attempts to answer these questions by examining the probable directions that computer technology will take during the next 20 years.

by DR RUTH M. DAVIS

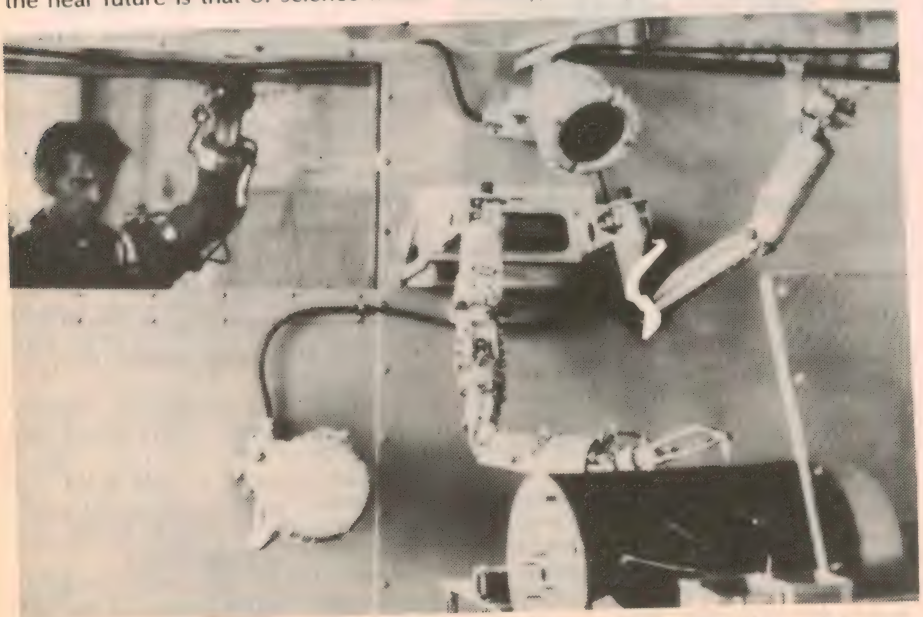
Dr Davis is the Director of the Institute for Computer Sciences and Technology at the US National Bureau of Standards (NBS).

People and computers will exist for the next 20 years. Further, computers and man will exist together within some benevolent structure, friendly to both, which will be a society of sorts. Everything that follows depends on a belief in these assumptions, because there is no proof for them that holds in the future.

Indeed, one of the most apparent shortcomings of human intellect is in predicting and preparing for the future. Therefore, looking at the new technology of computer science and guessing what the next 20 years will bring is an exercise worthy of all the skill, imagination and foresight we can muster.

I firmly believe that the best technique we possess for taking a realistic peek into the near future is that of science fiction modified by foreseeable man-made constraints such as individual concerns, institutional barriers, national priorities and budget realities. These constraints slow down the attainment of the idealised science fiction scenarios which seem so much better than the real world of today. Employing science fiction allows the freedom of unfettered scientific imagination to reign, with science playing centre stage.

Moreover, once we have cultivated our scientific imaginations and then qualified them with near-term realities, we will probably have done a fair job of technological forecasting. Using this approach will hopefully prevent one of the most common injustices we practice on computers and computer science; namely, treating their future in terms of incremental changes to their past.



One example of man with computer is found in the development of remotely controlled mobile systems for disarming faulty shells and other explosive devices.

What is desperately needed today is the ability to see a better tomorrow and to see how to get from today to that tomorrow. In addition to imagination, this task takes structure. The best structure we can introduce is one that highlights both the scientific ideas and the societal realities that will take us from today to the tomorrow for which we are aiming.

In dealing with computers, individuals and society, I suggest that we consider the world of tomorrow in terms of: man without computer; man with computer; computer with man; computer without man; and computer against man.

In looking at these alternate future worlds, it will be helpful to think of the computer as a scientific artifact rather than simply as a glorified adding machine or calculator.

Man without computer is best dealt with by simply asking that we remember the world before 1945 and transplant it into today's time period. There are few of us who would care to ride on planes today if there were no computers in our air traffic control systems.

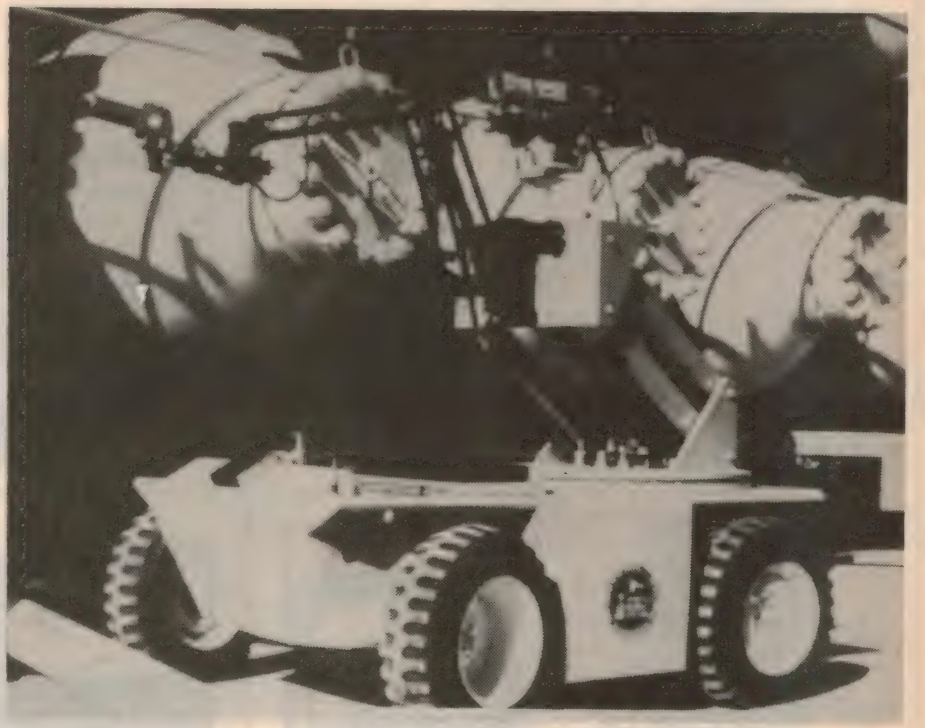
Waiting for credit to be approved or health insurance to be checked would be a tremendous time waster for most of us without the telephone or the computer.

There are, of course, many problems cited as due to the computer. Interestingly, and fortunately, however, recent polls have shown that most Americans properly attribute problems with computers to inadequacies in human management or to human error. These problems will disappear as we develop more expertise in computer science and technology.

Man with computer and computer with man are two situations which must be dealt with separately because there is a subtle difference between them. Man

AND SOCIETY

. . . IN THE NEXT TWO DECADES



Computer-controlled robot manipulators can carry out high dexterity operations that are hazardous, tedious or otherwise unsatisfactory for people to perform.

with computer implies that man is "using" the computer; computer with man implies that the computer is in control and is "using" man. The difference is subtle scientifically, but it is not subtle in the real world.

Labour unions have the most difficulty in accepting changes when technology upsets the relative supremacy of man over machine. This is quite apparent in cases of automation where industrial robots have been placed in assembly lines and workers have been relegated to such tasks as "oiling" the robots. Sabotage of automated assembly lines has been the recourse of labourers in several instances.

In the case of man with computer, a few concepts for the next 20 years that promise to bring us a better world will serve the point.

Most obvious are the extensive applications of computers and data links in banking, law enforcement, reservation systems, warehouse inventorying and libraries. The medical profession is also deep into these technologies in terms of computer storage of medical histories and computer diagnosis. Other evolving applications include the augmentation of man's intellectual efforts via computer manipulation of concepts and projection of man's manipulation capabilities into remote situations via teleoperators. For instance, the proposed undersea farms could be harvested and patrolled by teleoperator farmhands, controlled by sonar transmitters from the safety of surface ships.

By the end of the next two decades, these applications should be commonplace. Only unfounded prejudice and ill-conceived institutional barriers can prevent their happening.

The possibility of computers without man generally meets with annoyance or pious disbelief. But we already have limited instances of computer without man, for this situation is not synonymous with a world populated only by computers. Neither is it synonymous with computers as superior beings compared with man.

Computers without man does contemplate the carrying out of "intelligent" functions solely by computer-controlled devices with no intervention by man. And, indeed, this is a long overdue activity. There is no human rationale that can any longer justify placing man in hazardous and dangerous environments when experiments indicate that the tasks being performed by men can be done by computers. Environments falling in this class include underground mining, space exploration, prison surveillance, city safety patrols, firefighting and military security.

There would appear to be nothing inherently wrong with man being able to develop "something" that could, in any instance, perform intelligent tasks better than man could. As Carl Sagan put it, the problem seems to be one of human chauvinism.

There are two ways in which the phenomenon of computers against man can manifest itself. That is, in a one-on-one manner, where one computer is against one man; and where institutions with computers are against institutions without computers.

The latter instance is the more common. We see it with banks having computers competing with banks without computers; with scientific laboratories with computers competing with laboratories without computers; with airlines having computerized reservation systems competing with airlines not having them. It is rare that the computer owners do not "win" these competitions. It will be even more rare in the future.

The "one-on-one" situation is found in cases of computerized individual instruc-

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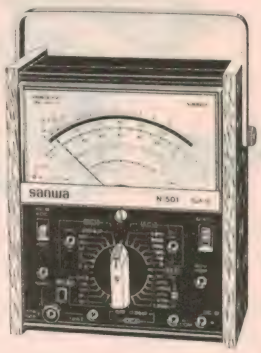

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±DCA 0-12μA
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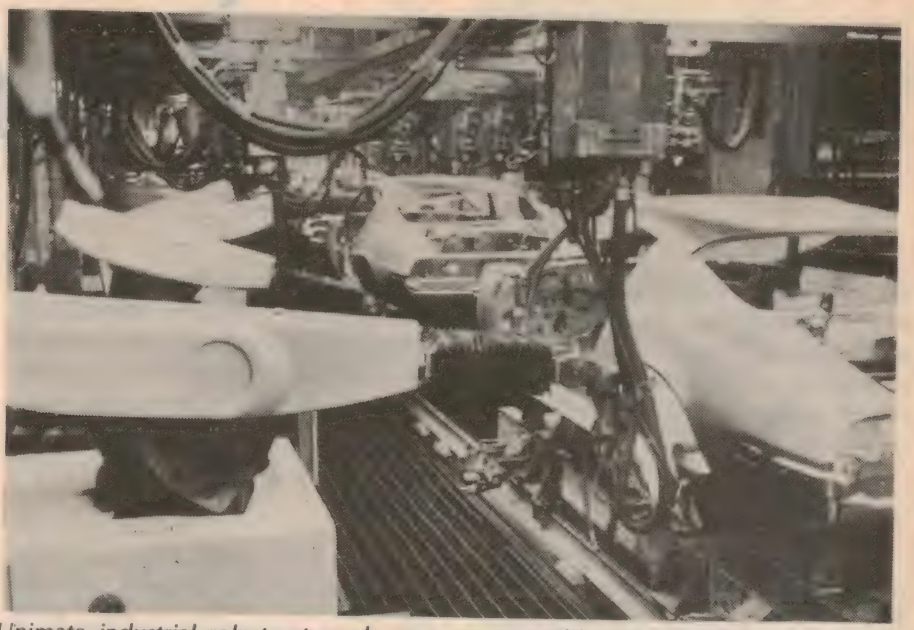
"the concern is . . . that we may become the victims rather than the masters of technology"



Unimate industrial robots at work on a car assembly line. Computer-controlled automation systems could replace man in a wide range of mass production tasks.

tion compared with manual instruction; with a doctor who employs computer-aided diagnosis compared with one who does not.

What, then, can be said in summary about the next 20 years in terms of computers and individuals?

Progress—or change—in the advanced, imaginative uses of computers will be despairingly slow, much slower, in fact, than in the last 20 years of computer innovations. This will be due to such problems as public reaction to further change in this field, lack of encouragement of scientific imagination in this area, continuing misunderstanding of the present and potential gains possible through computer science, and non-imaginative exploitation of this academic area by universities.

Imaginative advances will "go underground" rather than be subjected to the constraints imposed by public ignorance and institutional controls which bar change.

Decreasing costs and decreasing size of computers and logical devices will put these scientific artifacts into the hands of large numbers of individuals. We will see spurts of that "basement creativity" for which Americans are so renowned. Computer-related advances will be many, random and beneficial, although localized without large-scale diffusion.

Man coupled *with* computers will outlast man *without* computers, both individually and in groups.

Man is increasing the number of "intelligent" tasks for computers faster than he is increasing them for himself.

Computers will provide to the individual more control over his personal environment than he has ever before been able to exercise. This capability will result from the miniaturization of computer components along with the decreased cost of computer hardware.

Major government efforts will be directed toward the use of computers in response to demands for increasing public accountability. This will take the form of more computers used for more record-keeping tasks.

In the future, automation technology may be used in remotely controlled undersea oil drilling.

Dr Ruth Davis, Director of the Institute for Computer Sciences and Technology (ICST), National Bureau of Standards.

A great deal of managerial and scientific talent will be spent on defensive efforts to counter resistance to computer use in public service and safety functions.

The next 5 to 7 years will see a continuation of the current trend to isolate the scientist from the computer by a maze of operating systems and programming language barriers. This will perpetuate for a time the continuing diminution of advances in computer science and imaginative computer applications.

In spite of all man-made constraints, there will be an irreversible but slow trek to realize with computers forms of intelligent behaviour that are essentially limitless—transcending man and computer taken separately.

The concern of today is that people may become the victims rather than the masters of technology. To escape such a fate, we must decide what we wish for ourselves and apply technology to achieve our goals. But few people excel at changing fantasy into fact.

What is needed is to tackle the really impossible and take the working environment of today, the worker of today, the technologies we understand and try to effect a change into a more desirable working environment in the next 20 years. A more productive and happier citizen and a more comfortable society will result.

Time diversity techniques for reliable HF teletype

Signal fading due to path loss, noise, and interference have given HF radio a reputation for unreliability over the years. Modern techniques and state-of-the-art circuitry are now being introduced to combat these problems. This article describes a time diversity transmission system which is capable of providing reliable teletype data communications over poor HF links.

by GREG SWAIN

Despite the many advances in communications technology over the past 20 years, HF radio links will remain one of the mainstays of long-haul communications for the forseeable future. Cost factors and exact siting criteria mitigate against full use of other portions of the radio spectrum which support satellite and microwave communications, and for the present these can only serve to augment the traditional role of HF links.

The problems associated with maintaining reliable HF links are well known. They include frequency interference, signal fading due to short term path loss, impulsive noise, and the often less than optimum siting of equipment. All these factors have served to give HF radio a reputation for unreliability.

The transmission of teletype over HF links can thus pose considerable problems, with conditions deteriorating to such an extent as to make the error rate intolerable. In view of this, a great deal of research effort has been devoted in recent years to overcoming the problem and various techniques have been developed, the majority of these relatively ineffective.

However, one recently developed system has proven remarkably effective in achieving a dramatic reduction in the error rate. This system, known as time diversity transmission and reception, was developed in the United States by the Barry Research Corporation, California, and the United States Air Force (USAF), each apparently working separately from the other.

In simple terms, the time diversity technique involves multi-channel redundancy data transmission in order to achieve immunity to circuit drop-outs and noise bursts of up to several seconds in duration. Data is transmitted simultaneously over multiple teletype channels contained in a single voice channel, these channels being separated from each other in time. If sufficient redundancy channels are employed, the effects of noise and signal drop-outs (which are highly time variable) can be virtually eliminated.

Development of this technique has lead to the availability of a commercial system, which was recently released in Australia. Known as the Model 6028 Time-Diversity Equipment, the system is manufactured by Barry Research Corporation, California and employs sevenfold redundancy.

The Model 6028 time diversity system operates as follows: at the transmitter, the input teleprinter data is transmitted via seven frequency shift keyed (FSK) tones contained in a single 3kHz voice channel, with data progressively delayed in time. In the equipment under consideration, each data channel (except for Channel 1) is progressively delayed by one second. Thus Channel 1 is undelayed, Channel 2 is delayed 1 second, and so on until Channel 7 is delayed a total of 6 seconds.

Barry Research Corporation's Craig Werner visited Australia during the August 1975 IREE Convention to promote the company's newly developed time diversity equipment. Mr Werner, an applications engineer, was involved in the design of the Model 6028 Time Diversity Modem.

EXAMPLE SHOWING TIME-DELAYED TRANSMISSIONS
AND THE EFFECT OF FADING OR INTERFERENCE

TIME(sec)

CHANNEL	1	2	3	4	5	6	7	8	9	10
8----	THIS IS A TEST OF A TIME-DIVERSITY MODEM. THE QUI							OVER THE LAZY BROWN DOG.		
7----	TEST OF A TIME-DIVERSITY MODEM. THE QUICK BROWN F							AZY BROWN DOG. 12345678		
6----	TIME-DIVERSITY MODEM. THE QUICK BROWN FOX JUMPED						TWO	DOG. 1234567890 THIS IS		
5----	SITY MODEM. THE QUICK BROWN FOX JUMPED OVER THE L						SECOND	567890 THIS IS A TEST OF		
4----	. THE QUICK BROWN FOX JUMPED OVER THE LAZY BROWN						FADE	S IS A TEST OF A TIME-DI		
3----	CK BROWN FOX JUMPED OVER THE LAZY BROWN DOG. 1234							T OF A TIME-DIVERSITY MO		
2----	OX JUMPED OVER THE THE LAZY BROWN DOG. 1234567890							E-DIVERSITY MODEM. THE		
1----	OVER THE LAZY BROWN DOG. 1234567890 THIS IS A TEST							Y MODEM. THE QUICK BROW		

Channel	Delay(sec)
1	0
2	1
3	2
4	3
5	4
6	5
7	6
8	7

FIG: 1

The Barry Research Model 6028 Time Diversity Modem—available in Australia.

At the receiver end of the teletype link, compensating delays are inserted in each channel to reorder them to the same time reference. A voting system then takes place, the majority vote determining each output bit.

In this manner, the Model 6028 time diversity modem equipment can provide error free teletype output in the event of total fade or noise burst durations of up to three seconds. Figs 1 & 2 illustrate this principle. These demonstrate how an 8-channel system can completely eliminate a signal fade of 2 seconds duration.

The total outage that can be tolerated by any system before errors are printed is half the maximum delay time. Thus a 7 channel system can tolerate an outage of 3 seconds in every 6 seconds, an 8 channel system can tolerate an outage of 3.5 seconds in every 7 seconds, and so on (assuming of course that each channel is progressively delayed by 1 second).

Tests conducted independently by the USAF and Barry Research Corporation have shown a character error rate improvement of typically two, and often three, orders of magnitude over a frequency diversity comparison channel. Both tests were conducted over poor HF links approximately 1,600km long. In some instances, according to the USAF, the uncorrected copy ran as high as 28 percent errors, while the corrected copy remained error free.

Getting back to the equipment itself, the Model 6028 Time-Diversity Equipment is made up of two parts—the Model 6028T transmitter and the Model 6028R receiver. A full-duplex unit, the Model 6028, is also available for use at a duplex radio terminal. The system operates without adjustments, controls or operator attention.

Either synchronous or asynchronous data, clear or encrypted, at rates up to a maximum of 75 baud may be used. A meter mounted on the front panel indicates residual error rate, serving to warn the operator of deteriorating circuit conditions.

The composite signal output from the Model 6028 can be fed to a teleprinter via a number of interface options. These options include either 20mA or 60mA current loops, or a 1275Hz plus or minus 42.5Hz tone keyer. Use of the latter dictates that a suitable modem forms an integral part of the teleprinter equipment.

Readers requiring further information on the Model 6028 Time-Diversity Equipment should contact the Australian distributors, Gollin and Company Pty Ltd, Gollin House, 40-50 Clarence St, Sydney.

EXAMPLE SHOWING RECONSTRUCTION OF TRANSMITTED MESSAGE

Time(sec)

	1	2	3	4	5	6	7	8	9	10
CHANNEL										
8	THIS IS A TEST OF A TIME-DIVERSITY MODEM.					THE QUI			OVER THE LAZY BROWN DOG.	
7	THIS IS A TEST OF A TIME-DIVERSITY MODEM.					THE QUICK BROWN F			AZY BROWN DOG.	
6	THIS IS A TEST OF A TIME-DIVERSITY MODEM.					THE QUICK BROWN FOX JUMPED				DOG.
5	THIS IS A TEST OF A TIME-DIVERSITY MODEM.					THE QUICK BROWN FOX JUMPED OVER THE L				
4	THIS IS A TEST OF A TIME-DIVERSITY MODEM.					THE QUICK BROWN FOX JUMPED OVER THE LAZY BROWN				
3	THIS IS A TEST OF A TIME-DIVERSITY MODEM.					THE QUICK BROWN FOX JUMPED OVER THE LAZY BROWN DOG.				
2	THIS IS A TEST OF A TIME-DIVERSITY MODEM.					THE QUICK BROWN FOX JUMPED OVER THE LAZY BROWN DOG.				
1	THIS IS A TEST OF A TIME-DIVERSITY MODEM.					THE QUICK BROWN FOX JUMPED OVER THE LAZY BROWN DOG.				

Channel	Delay(sec)
1	7
2	6
3	5
4	4
5	3
6	2
7	1
8	0

FIG: 2

NBS brightens the way for highway safety

Inadequate road conditions are a major contributing factor to road accidents, particularly where the road is poorly marked at night or in rain. In the United States, the National Bureau of Standards is conducting research aimed at alleviating this problem. Currently under development is an electrically lighted lane marker system that is acoustically triggered by oncoming traffic.

One of the most frightening aspects of modern-day driving is groping along an unfamiliar road on a rainy night. "The lack of lane guidance at night in rain remains one of the most critical of highway safety problems," states the US Federal Highway Administration (FHWA).

The problem has been solved in southern states by supplementing conventional painted stripes with raised reflective markers. In northern states, however, snowplows damage the raised markers and they cannot be used. At the present time, FHWA is trying to modify these markers to make them resistant to snowplow damage.

They are also exploring other possibilities and have found some indication of success with electrically lighted lane markers recessed in the roadway. These snowplow-proof markers concentrate the light from a low-power lamp into a narrow, nearly horizontal beam directed at approaching drivers.

The markers are connected by a transformer to commercial power lines and they operate continuously during the night-time hours. Because of the tremendous amount of energy that this system uses, FHWA is interested in developing an alternative method that lights the markers only when traffic is approaching.

They have turned to the National Bureau of Standards to test the technical feasibility of one such system. It is a modern-day adaptation of the Indian practice of putting an ear to the ground to detect—by the vibration of the earth—the presence of horses that are too far away to be seen. The modern version is to attach piezoelectric sensors to the roadway to detect the pavement-borne sound from approaching vehicles. The sensor is typically the size and shape of a half dollar and has electrodes attached to the opposite surfaces. It is piezoelectric because mechanical deformation of the sensor, caused by vibration, produces a voltage across the electrodes. A metal seismic mass of the same diameter is sometimes placed over the sensor to increase its sensitivity to vibration.

No traffic-sensitive electrical marker system has been constructed prior to this time. NBS, and more specifically James M. Kenney of the Polymers Division, has been conducting road vibration measurements to determine if such a system is technically feasible. "From my preliminary measurements it looks as though it will work," says Kenney.

Kenney believes a polymer sensor he has been testing will be the most practical device. It would cost only pennies to produce in quantity. A car could run over it without breaking it. "And it should be easier to put down on the roadway," Kenney says.

Under guidelines established by the FHWA, the triggering signal from the sensor circuit must activate the warning light when a vehicle weighing about 900 kilograms (2,000 pounds) or more approaches at a speed of about 50 kilometres (30 miles) per hour or faster and is no closer than 25 metres (82 feet) to the marker.

For the past several months Kenney has been travelling the highways of Maryland to field test sensors on a variety of road

View at left shows Kenney using an oscilloscope to analyse field data in the laboratory. Above, Kenney setting up a transducer at the edge of a heavily travelled highway.

surfaces. He plasters the transducer to the roadway and then records on tape the very-low-frequency noise vibration in the roadway caused by vehicles approaching the sensor at distances greater than about 30 metres (100 feet).

First he had to determine the frequency spectra of vibration noise that traffic makes, then he had to select a sensor that will pick up this noise under the FHWA guidelines. Kenney is now developing a baseline for this noise that would be applicable for various types of roads surface and traffic patterns.

To hear the playback of his tapes (raised in frequency 10 times) is like listening to static on the radio or sounds that Kenney relates to "the bombardment of Fort McHenry."

Although he often spent 4 and 5 hours a day just off the shoulders of some of the nation's more heavily travelled highways, Kenney said the only really dangerous part of his project, aside from dehydration in the hot sun, was attaching the transducer to the roadway while traffic whizzed past him. To protect himself —and his equipment—he borrowed traffic cones from the NBS security force and placed them around his work area. No one other than an occasional curious policeman ever stopped to ask him what he was doing.

One interesting offshoot of his work was the discovery of significant roadway background vibrations in the absence of nearby traffic. As there is more and more residential and commercial construction along the nation's super highways, Kenney believes that long-distance vibrations will become an important environmental consideration. Persons wishing to build along major highways and railways may wish to measure the vibration level first to determine if it would have any deleterious effect on structures or individuals.

Kenney attaching the transducer cable to the tape recorder used to record the noise vibrations of oncoming traffic.

Reprinted from "Dimensions", by arrangement with the US National Bureau of Standards.

BUILD YOUR OWN HOME TV GAME!

With the Videomaster Home TV Game Kit, you can be the first one in your street to have one of the new video games which are currently all the rage in Europe and the USA. Using modern CMOS integrated circuits and simplified PC board construction, it is easily assembled in a few evenings.

by JAMIESON ROWE

For those of you who haven't come across one as yet, a home video game is a gadget which works in conjunction with a normal black-and-white or colour TV set to let you play games of skill. The TV set is used as a monitor, with signals fed into it via the normal aerial terminals so that modifications are unnecessary. The video game unit generates a pattern on the TV screen which represents say a tennis, or squash court, and the players are able to control a light spot "ball" using small control units.

There are all sorts of games possible, and they can call for a great deal of skill and dexterity. Even if you're not too good at winning, they can be great fun—for all the family.

As some of you may already know, video games have been available overseas for a couple of years. The first games to hit the market were quite expensive, but as prices have come down they have met with a very enthusiastic response. Some of the marketing experts predict that from now on, they're going to grow almost as fast and big as calculators.

We haven't seen many here in Australia as yet, although you may have seen coin-in-the-slot versions in some of the bigger suburban shopping complexes. Those few that have been imported for sale to the public have been rather expensive, and this has slowed things up.

Now, however, there's a way of getting yourself one of these fascinating new gadgets at quite a reasonable cost, and before most other people. Thanks to that irrepressible electronics "nut", Dick Smith, who is importing "Videomaster" game kits from the UK, you can assemble your own game in a few evenings. The kit sells for $89 including tax, and comes complete with a comprehensive assembly and instruction manual.

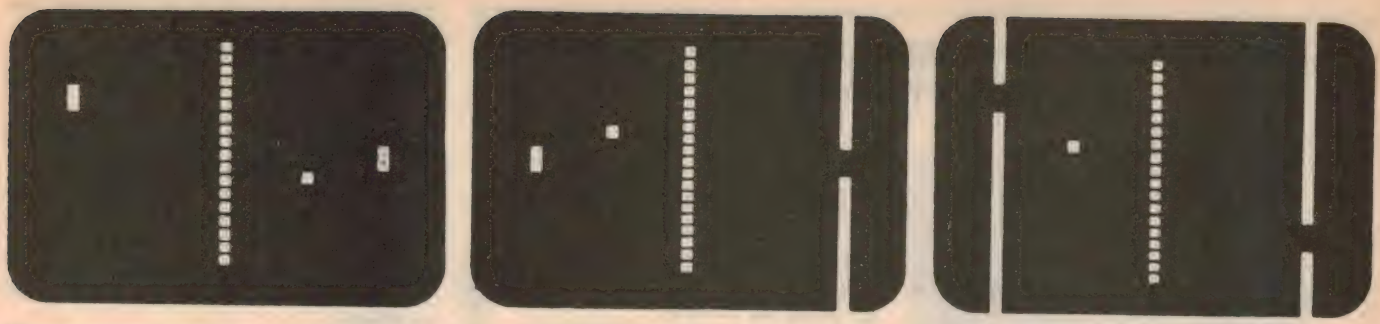
It provides not just one game, but a choice of three. One is labelled "ping-pong", and is virtually the same as tennis. There is a "net" up the centre of the screen, and each player has a small rectangular "bat" which can be moved up and down on one side of the screen. The object is to cause your opponent to miss the "ball".

Somewhat harder to play is the second game provided, which is labelled "catch ball". Here the "bats" are replaced by vertical "walls" with "holes" in them, and the object is to move your hole up and down so as to "catch" the ball before your opponent. The problem is that the holes are not only under player control—they are "jiggled" up and down as well, by the game circuitry!

The third game is "solo", which is a single player version of "catch ball". Here the player has a bat again, but the opposite side of the net has a wall with a jiggling hole. The object is to hit the ball whenever it comes over your side, and at the same time try to get it through the hole in the wall.

Any one of the three games may be selected as desired by means of a slider switch on the game unit. There is also a control to adjust ball speed—and its range should more than cover what most people will need. With the control set for

Here is the game when fully assembled. Each player has one of the two small control boxes.



These patterns give you an idea of the three games provided by the Videomaster unit. From left to right: ping-pong, solo, and catch ball. The central "net" is purely ornamental.

minimum speed, even beginners can have satisfying "volleys", while maximum speed will provide plenty of challenge even for seasoned "professionals"!

The players have small control boxes which are provided with rotary control knobs for the "bat" or "hole" movement, together with push-buttons which are labelled "serve". One or the other button is used to bring the ball back into the screen, when it is missed or caught out.

Most of the game circuitry is on a PC board which mounts in an attractive box moulded from impact-resistant plastic. The box measures a modest 232 x 135 x 56mm, and is fitted with a professional-looking photo-finished panel. The player control units are housed in matching cases which measure 100 x 64 x 50mm, with similar panels. They are provided with cords about 1.5m long, terminated with 5-pin DIN plugs which connect them to the main box circuitry.

The complete game circuit is powered from a small double-ended 9V battery, such as the Eveready type 2362 or similar. Thanks to the use of modern CMOS integrated circuits for most of the game logic, the overall current drain is only around 20mA, so that the battery should have quite a reasonable life. The eleven CMOS ICs used are of the National Semiconductor 74C00 series, and only two common types are used: the 74C00 and the 74C02. These are readily available from local suppliers should you be unlucky enough to need replacements.

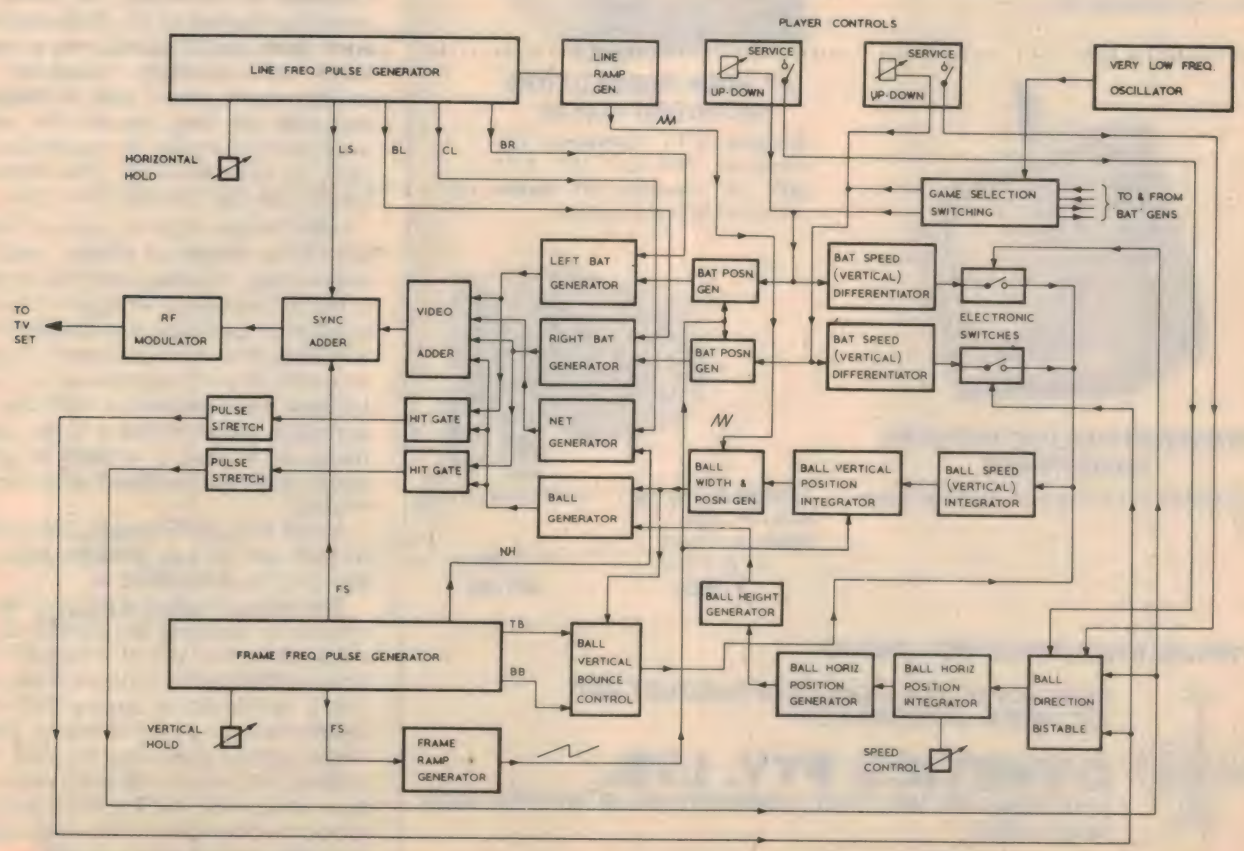
Apart from the eleven ICs, there are only four transistors and eleven diodes in the main part of the game, together with some 48 resistors and 31 capacitors. The VHF modulator section is supplied pre-wired and tested in a small metal box, which simply drops into the board.

In short, then, the kit does not involve a lot of assembly, and the finished game is both attractive, practical and rugged. These features should make it a source of challenging fun, both as an assembly kit and as a family game for years to come.

At Dick Smith's invitation, I tried putting one of the Videomaster kits together so that we could give you a first-hand report. Here it is:

Upon opening the sample kit, my first impression was very good. The instruction manual appeared to be well produced, with a good deal of down-to-earth material for those without much experience in kit building—like component descriptions and pictures, and hints on assembly techniques and soldering.

The kit itself seemed to be very



The block diagram for the Videomaster game, which uses only eleven CMOS integrated circuits. Operation is explained in the kit manual, which also gives a comprehensive troubleshooting guide.

HOME TV GAME

complete, down to the last nut, bolt and washer. There were lengths of hookup wire, in various colours, and even a roll of resin-cored solder. The only obvious things required from the kit assembler were the 9V battery, a soldering iron, a few simple tools, a little skill and a few hours of time!

I'm happy to report that this initial impression regarding both the manual and the kit has turned out to be very close to the mark. I made a point of following the manual fairly closely, and apart from a couple of points which I'll explain shortly I think it is an excellent guide. And as for the kit itself, it did indeed prove to have virtually everything apart from the battery.

The PC board proved to be cleanly etched and accurately drilled, and was provided with clear silk-screened legends to make component placement and orientation easy. This together with the clarity of the manual made assembly quite straightforward.

There were a few minor hassles, like the difficulty of fitting moulded-case .01uF capacitors with short-cropped leads into holes in the PCB which have obviously been drilled with spacing for ceramic types. And the problem of deciding which of three different types of 6BA screw supplied were the ones intended for mounting the battery restraining bracket to the PCB. But these were fairly easily solved; the capacitor leads were carefully "cranked" with needle-nosed pliers, and it transpired that with the only suitable 9V battery available in Australia, the battery bracket can't be used anyway! (The battery is longer than the intended UK type).

I did deviate from the manual instructions in a couple of places, and quite deliberately. Possibly with the beginner in mind, they advise fitting all of the components of each type to the board before soldering those components in. I elected to solder in each component as I went, because past experience with the other approach suggests that it is too easy to overlook at least a couple of joints—which don't get soldered until they give trouble!

It may take a little longer, but soldering in each one as you go does make sure that they're all soldered in.

The manual makes a point of the care needed in handling the CMOS ICs, and wiring them into circuit. It possibly overstresses the fragility of these devices, but this is no doubt to ensure that the kit builder doesn't push his luck by attempting to solder them into the PCB with a leaking unearthed 100-watt mains voltage iron, while sliding back and forth along the deep-pile nylon shag carpet in his rubber-soled tennis shoes!

I took my usual precautions of making

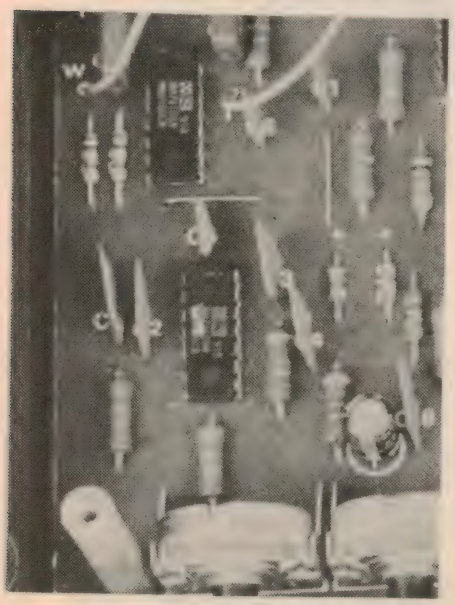
sure the low-voltage iron was earthed, and of wiring the ICs to the board with it resting on a sheet of cardboard. My workshop doesn't have carpet on the floor, and the weather being quite hot and muggy, I didn't have any shoes on at all. Needless to say, all ICs were soldered in without any casualties.

In passing, I do have one little gripe about the manual in this context: at the bottom of page 7, it rightly warns against the use of continuity testers based on an electric bell or buzzer. However it suggests the use of a multimeter set on the lowest ohms range. This is not really very desirable either, as the current capability of most multimeters on the lowest ohms range is usually sufficient to cause melting of a semiconductor junction should the meter be connected across one. A far better idea, in my experience, is to use the ohmsx10 or ohmsx100 range. This generally still uses the same 1.5V source, but is only capable of providing a milliamp or so.

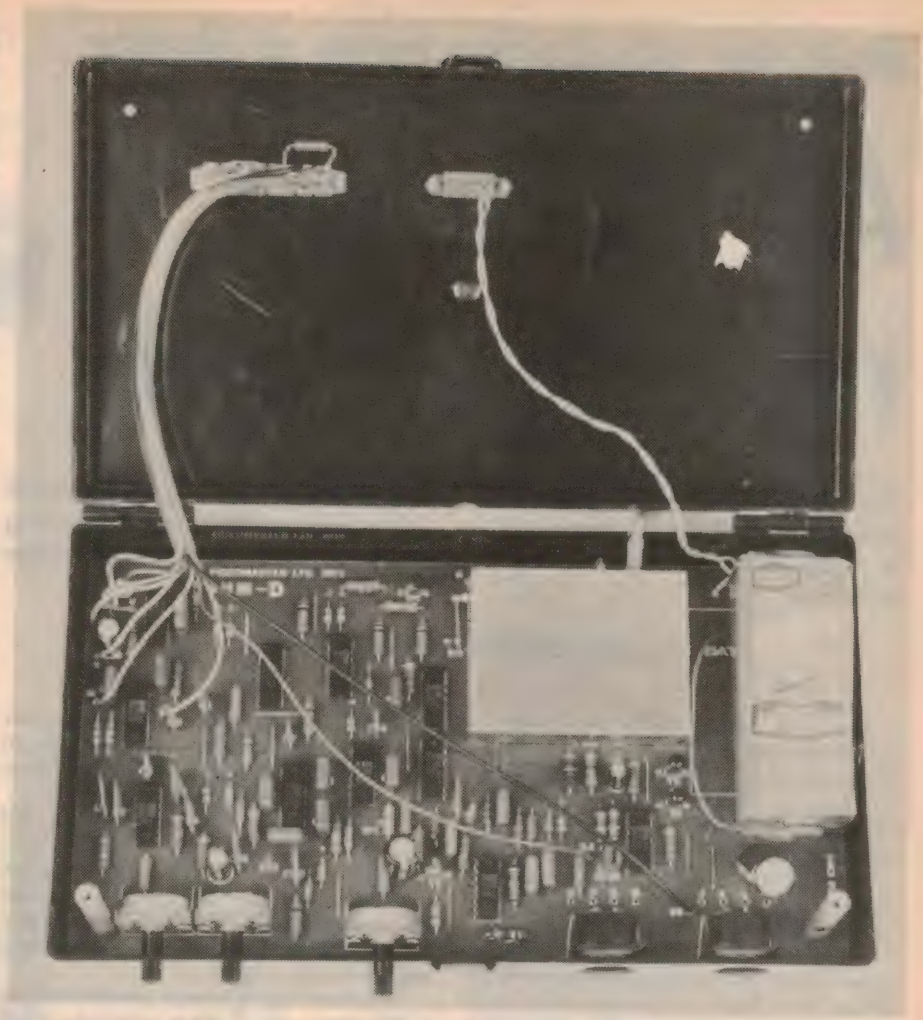
Assembly of the complete kit, including the two control boxes and their leads, took me about 5 hours. I wasn't hurrying, so that even if you're quite new to assembling electronic kits, it shouldn't take you much longer. If you are really impatient, you could probably wire it up and get it going in a single evening—although like all such kits it tends to be a little tedious, and is probably best spread over 2 or 3 evenings to ensure that you're really on the ball.

When I completed assembly and hooked the game up to a battery and a TV set, it was fairly easy to find the RF signal from the game and tune it in on the set. But while there was obviously a strong RF signal, it was also quite obvious that there wasn't a sign of any modulation!

This was admittedly somewhat disappointing, but it provided the impetus to read through the section of the manual describing the circuit operation, and giving troubleshooting information. This section of the manual is very well produced, by the way. It not only gives a circuit schematic, block diagram and PCB wiring diagram, but also quite an extensive faultfinding checklist and servicing guide.



A close-up of the game PCB, showing the "missing link" (horizontal) between the two integrated circuits.



The main case of the video game unit opened to show how easy it is to put together. The metal box is the pre-assembled RF modulator.

As it happens (Murphy's law!), the fault of "no modulation" wasn't actually covered in the checklist, so that I had to solve the fault for myself using the circuit and PCB wiring diagram. Being such a significant fault, it wasn't too hard to track down, although tracing through an unfamiliar board pattern takes time.

But before very long it became apparent that the horizontal sweep oscillator wasn't working, and that this was because two holes and pads in the PCB which hadn't been mentioned in the manual were obviously intended to be joined by a wire link. When I added the link, the game suddenly sprang into life, with everything working.

Incidentally, the link concerned runs just at the front of the IC identified as "N4". It runs parallel to the long axis of the board, between this IC and the 100pF ceramic capacitor labelled "C6". Although the manual text only mentions 12 links, and the PCB silk screening doesn't indicate a 13th link here, the PCB diagram does show the link if you look closely. In any case, I can assure you that the link is essential.

With the game finally going and hooked up to the TV set, all that has to be done is to adjust the two hold controls on the game to give a stable picture on the set—without touching the set's own hold controls. You may also have to tweak the set's fine tuning on the channel concerned, to get a full contrast picture.

The other control on the game unit sets ball speed, and this is best set after you try playing the games. It is variable over quite a large range, from "too slow" to "too fast".

You're all set then to play video games. One thing, though: it mightn't be a good idea to get the unit going on a night when there's a really good program scheduled. You might think that video games are only for kids, but there's just a chance you may get sucked in yourself. Don't be surprised if you can't find any programs on the other channels when you turn off the Videomaster game—they'll probably have gone off the air for the night!

Build this fascinating game of chance

An electronic roulette wheel

Are you interested in games of chance? If so, then our Electronic Roulette Wheel is the thing for you. Fully solid state, and functioning in a suitably random manner, it will keep you amused for hours at a time.

by DAVID EDWARDS

Man has always been fascinated by games of chance, and one of the most popular forms of this mania is the wheel of fortune. Ranging from the simple chocolate wheel as used at fetes, to the complicated machines employed by casinos, these devices always seem to attract large crowds of people willing to "have a go".

Much care is required in the construction of these machines, to ensure that the wheel runs true, so that the final result is completely random, and not biased in any way. Anyone who has seen a roulette wheel in a casino will appreciate the skill and workmanship required.

Our Electronic Roulette Wheel has no moving parts, and thus does not require the same skills in construction. It is based upon an electronic number generator, which cannot be "fiddled" in any way. Admittedly, it does not have the same visual appeal as a large wheel which gradually slows down before stopping at the final number, but at the same time it is considerably less expensive, and does have a visual appeal of its own.

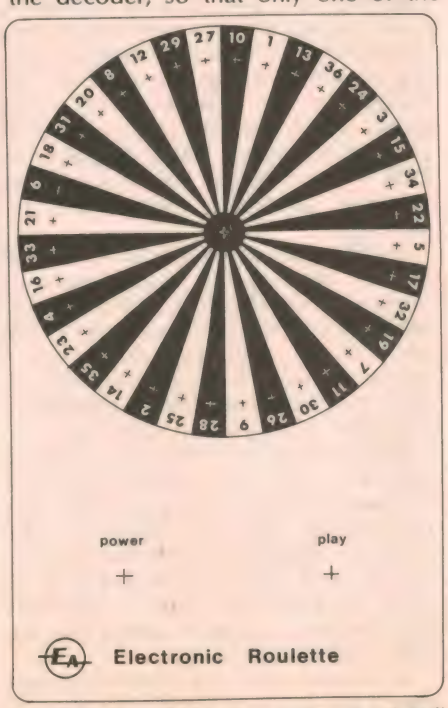
As you can see in the photographs, our unit consists of a fairly large box, fitted with thirty-six small lights, arranged in a circle. The circle is divided into alternate black and white segments, with each segment being numbered at random from one to thirty-six. Only one of these lights is illuminated at any one time.

When the PLAY button is pressed, the lights appear to move rapidly round the circle. Once the button has been released, the lights start to slow down, just like a true roulette wheel, and eventually come to a stop at some randomly selected number.

Fig. 1 is a block diagram explaining the way in which we have implemented the necessary functions. The clock generator is controlled by the PLAY switch. When the switch is depressed, the oscillator runs at a high speed, and feeds pulses to the divide-by-eighteen counter. After the switch is released, a time constant in the clock circuit makes the clock slow down to a stop in about 14 seconds.

The outputs from the counter are fed to a decoder, which has eighteen outputs. These are normally high, and each one goes low in turn as the counter cycles through its states. When the counter has reached eighteen, it is reset, and starts counting again.

This reset signal is also used to trigger a flip-flop, which thus changes state every time the counter re-cycles. The complementary outputs from the flip-flop are used to gate the outputs from the decoder, so that only one of the lamps connected to each decoder output is energised at a time. When the Q output of the flip-flop is high, lamps 1 to 18 are energised sequentially. The counter then resets, the flip-flop changes state, and lamps 19 to 36 are energised sequentially. The cycle then repeats for as long as clock pulses are supplied.



The front panel of our roulette wheel. Full size dyeline copies, positive or negative, are available, price $2.00.

Physically, the lamps are arranged in a circle, so that each one is illuminated in turn. Visually, the energised light appears to be rotating in the same way as a normal roulette wheel does.

Initially, when the clock is running at a high speed, it is impossible to distinguish between individual lights, all one sees is a blur of light in a circle. However, as the clock shows down, one is able to see a rotating pattern, until eventually, the individual lights can be seen. Finally, only one light will remain illuminated.

This final light is randomly selected because it is impossible to ascertain exactly when the PLAY switch is released. This uncertainty is due to the high initial clock speed. Extensive (and time consuming!) tests with our prototype failed to show any bias whatsoever.

Since our design is only capable of providing an even number of digits we decided not to have any zeros on our wheel. Zeros are normally provided to give a bias in favour of the casino. Having no zeros means that our wheel will not favour the banker over any player.

We decided to use TTL logic to implement our design, on the grounds that it is readily available, economical, and is capable of driving light emitting diodes (LEDs) directly. Although it has a high power consumption, we felt that for a mains powered device, this would not be too great a disadvantage.

The other main decision to be made concerned the type of lights to be used. While incandescent lamps are quite cheap, they are not capable of interfacing directly with TTL logic, due to their high current drain. In this respect LEDs are quite suitable, their only disadvantage until recently being price, particularly where, as in our case, large numbers

were required.

Fortunately, in recent times, the price of LEDs has fallen drastically. They are now selling, in quantity, for less than 20c each. In some cases this includes a mounting kit for each LED. This is very good value.

Having decided on the general scheme of things, as described above, we were then faced with realising our design. Implementation of the clock generator did not prove difficult. As you can see from Fig. 2, we have used a type 566 function generator.

This is a voltage controlled oscillator with both triangle and square wave outputs. The basic oscillator frequency is set by the resistor connected to pin 6, and the capacitor connected to pin 7. With the values we have used, this gives a frequency of about 1700Hz.

The frequency is also influenced by the voltage on pin 5. With the PLAY switch pushed, this voltage is a minimum, and the frequency is a maximum. When the switch is released, the 220uF capacitor commences to charge. This increases the voltage, and progressively lowers the frequency, until the oscillator stops completely. This takes about 14 seconds.

The recommended supply voltage for the 566 is 12V, and the current drain about 10mA. This is quite easily provided, but more about that later.

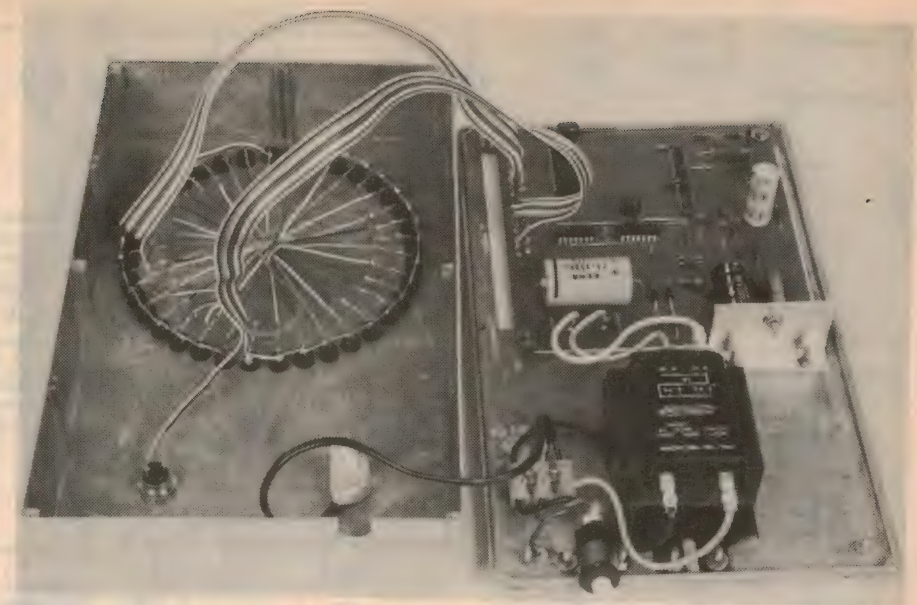
The square-wave output from pin 3 must be conditioned to suit TTL logic levels. This is done by the BC548 NPN transistor. The conditioned clock signal is then applied to the input of a 7493 type 4-bit binary counter.

This is converted into an eighteen stage counter by the addition of a J-K flip-flop and a 3-input NAND gate. The flip-flop is clocked from the output of the 7493. The NAND gate is used to generate a signal when the nineteenth count is reached, and this is used to reset the counter to the zero state. An inverter is necessary between the clear input of the flip-flop and the preset input of the counter, while two series inverters are used to "stretch" the reset pulse to ensure reliable operation.

The eighteen line decoder is formed from a 74154 MSI 4-line to 16-line decoder, in conjunction with two 3-input NAND gates and two inverters. A signal applied to the strobe input of the 74154 disables it during the seventeenth and eighteenth counts, preventing spurious outputs.

Two small signal PNP transistors are used to buffer the output of the flip-flop used to select either of the two groups of LEDs. Resistors (120 ohms) in the collector leads serve to limit the LED current to about 20mA.

The configuration adopted is quite economical in terms of package utilization, only 6 ICs are used, and all of these are used fully except for one inverter. Total current drain of the circuit is about 130mA, from a 5V rail.



This picture gives a good idea of the complete layout. Note the "L" shaped bracket, to the right of the power transformer, which supports the BD135 transistor. The wiring board is mounted on spacers, with a sheet of cardboard beneath it as a precaution.

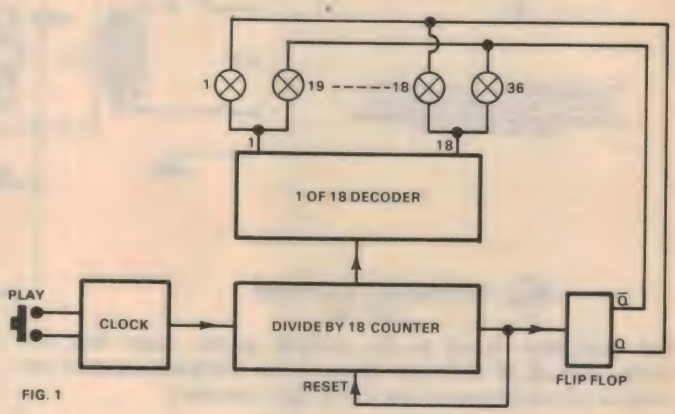


FIG. 1

Block diagram of the roulette wheel. Pulses from the clock are fed to the divide-by-18 counter and thence to the decoder. The flip-flop converts the 18 outputs to 36 outputs for the LED display.

PARTS LIST

SEMICONDUCTORS

1 74154 1-of-16 decoder
1 7493 4 bit binary counter
1 7473 dual J-K flip-flop
1 7410 triple three-input NAND gate
1 7404 hex inverter
1 566 function generator
1 BD135 NPN power transistor, or equivalent
1 BC548 NPN transistor, or equivalent
2 BC558 PNP transistors, or equivalents
4 EM401 silicon diodes, or equivalent
37 LEDs, with mounting clips. See text
1 5.6V 400mW zener diode, BZX79C5V6 or equivalent
1 6.8V 400mW zener diode, BZX79C6V8 or equivalent

CAPACITORS

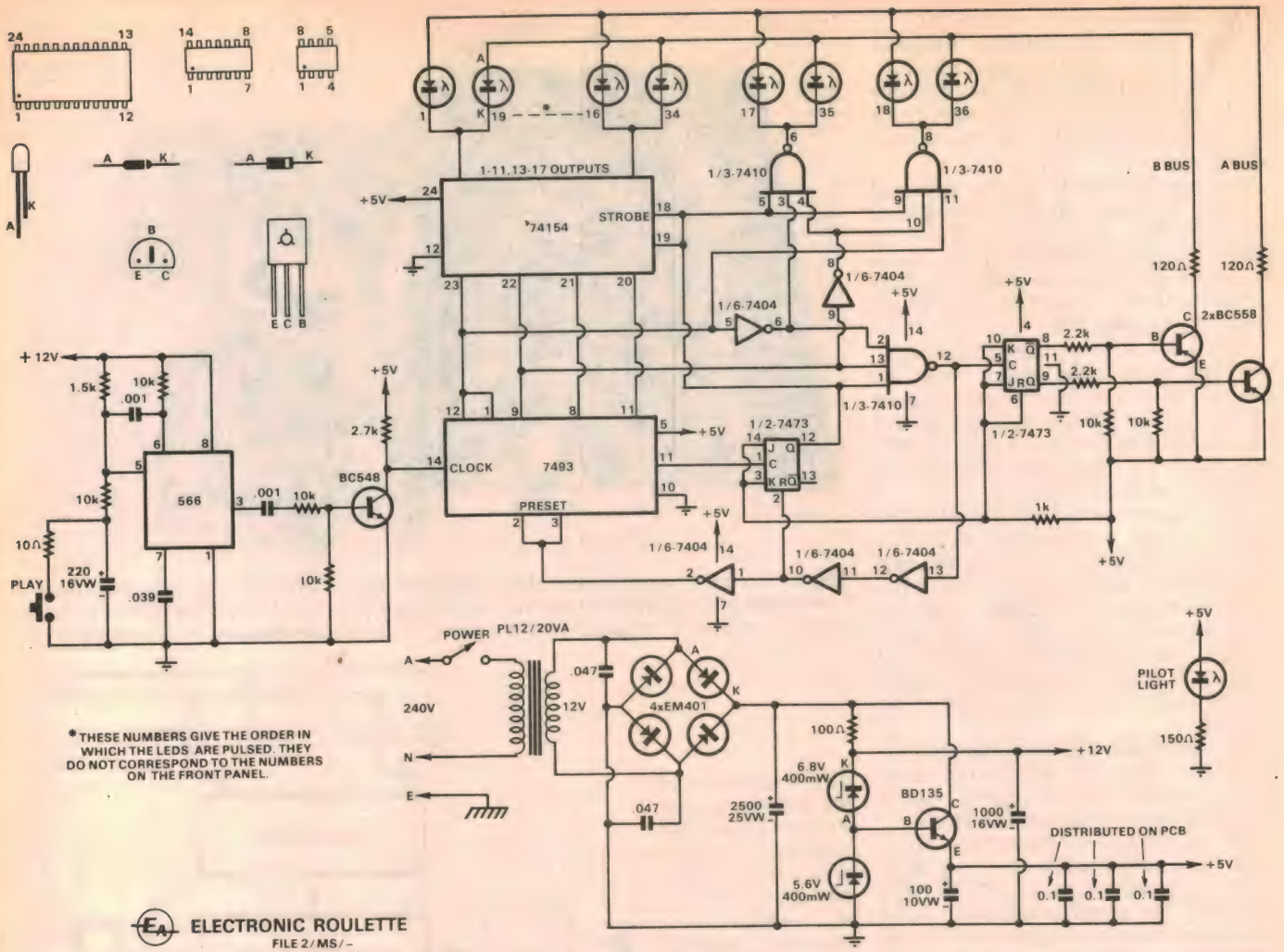
1 2500uF 25VW pigtail electrolytic
1 1000uF 16VW pigtail electrolytic
1 220uF 16VW PCB electrolytic
1 100uF 10VW pigtail electrolytic
3 0.1uF plastic
2 0.047uF ceramic
1 0.039uF plastic
2 0.001uF plastic

RESISTORS (½ watt rating)

6 10k, 1 2.7k, 2 2.2k, 1 1.5k, 1 1k, 1 150 ohm, 2 120 ohm, 1 100 ohm, 1 10 ohm

MISCELLANEOUS

1 printed circuit board, coded 76rt3, 140 x 140mm
1 transformer, 240V to 12V, PL12/20VA or equivalent
1 diecast box, 170 x 272 x 55mm
1 front panel, see text
1 240V rated, push on-push off switch
1 N/O momentary contact push switch to match
1 mains plug, 3-core flex, grommet, cord clamp and 3-way terminal block
4 rubber feet
Scrap aluminium, machine screws, nuts, washers, solder, hookup wire, rainbow cable, mica washer, silicon grease, circuit board pins



*THESE NUMBERS GIVE THE ORDER IN WHICH THE LEDS ARE PULSED. THEY DO NOT CORRESPOND TO THE NUMBERS ON THE FRONT PANEL.

EA ELECTRONIC ROULETTE
FILE 2/MS/–

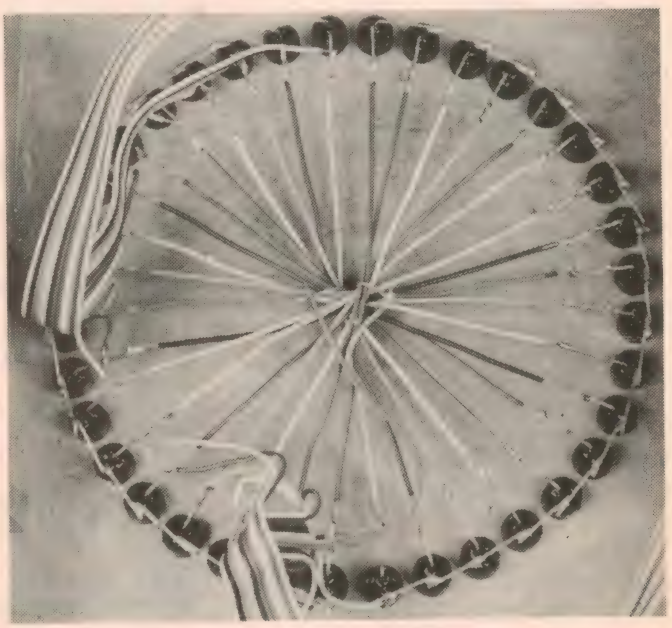
The complete circuit of the roulette game. Note that, for clarity, not all 36 LEDs are shown. The numbers next to the various circuit elements are the IC pin numbers.

We have used a LED as a pilot light, and placed it in the centre of the circle of LEDs. While this is not strictly necessary, as one of the other LEDs will always be illuminated, we felt that it improved the look of the circle, by providing a point of interest at the centre. If desired, it can be deleted.

We have used a fairly simple power supply. A full-wave bridge rectifier feeding into a 2500uF electrolytic capacitor supplies a nominal 20V from a 12V rms transformer. Two 400mW zener diodes in series provide nominal outputs of 5.6V and 12.4V. The latter is used to power the 566 clock generator direct. Extra filtering for this is supplied by the 1000uF electrolytic capacitor.

The 5.6V zener drives a series pass transistor, giving a nominal output of 5V. This is stabilised by the 100uF electrolytic capacitor at the output. We have used one of the plastic type transistors, as this is easily mounted on a suitable heatsink. The collector-emitter power dissipation is approximately 2 watts.

We mounted our prototype in a standard die-cast box, measuring 170 x 272 x 55mm. As can be seen in the photographs, we mounted the LEDs on the bottom of the box, towards one end. We used two push switches, identical in appearance, for the POWER and PLAY functions.



A close-up of the LED wiring. All the cathode leads point towards the centre of the circle and are bridged to the cathode of the LED directly opposite. The anode leads are connected to form two semi-circles, each of 18 LEDs.

We made a front panel for our device using "Scotchcal" photosensitive aluminium. We anticipate that kitset suppliers will be able to make available ready-made front panels. Alternatively, we can supply through our Information Services copies of our artwork. These are full size transparent dye-lines, suitable for use in making bromide prints by the contact method. We suggest that fairly "contrasty" paper is used. (Priced $2.00.)

Construction should be relatively simple, as all major parts are mounted on the printed circuit board. This is coded 76rt3, and measures 140 x 140mm. There

HOW TO PLAY ROULETTE

Roulette is played with a roulette wheel, chips and a betting table. Bets are made by placing chips on the specially marked table. The wheel is then used to select a winning number at random. A normal wheel, as used at a casino, has 36 numbers, and one or two zeros. The zeros are to provide a bias in favour of the casino. Our Electronic Roulette Wheel does not have any zeros, and is thus completely unbiased.

At least two players are required, one of whom becomes the banker. Players bet against the banker, but cannot bet amongst themselves. Each player should be supplied with an equal number of chips. If possible, each player should have different coloured chips, to avoid confusion when many bets are laid on the table.

The banker should be supplied with larger numbers of chips of all colours, to lessen the chance of "breaking the bank". Chips can be improvised from buttons, coloured counters or similar objects.

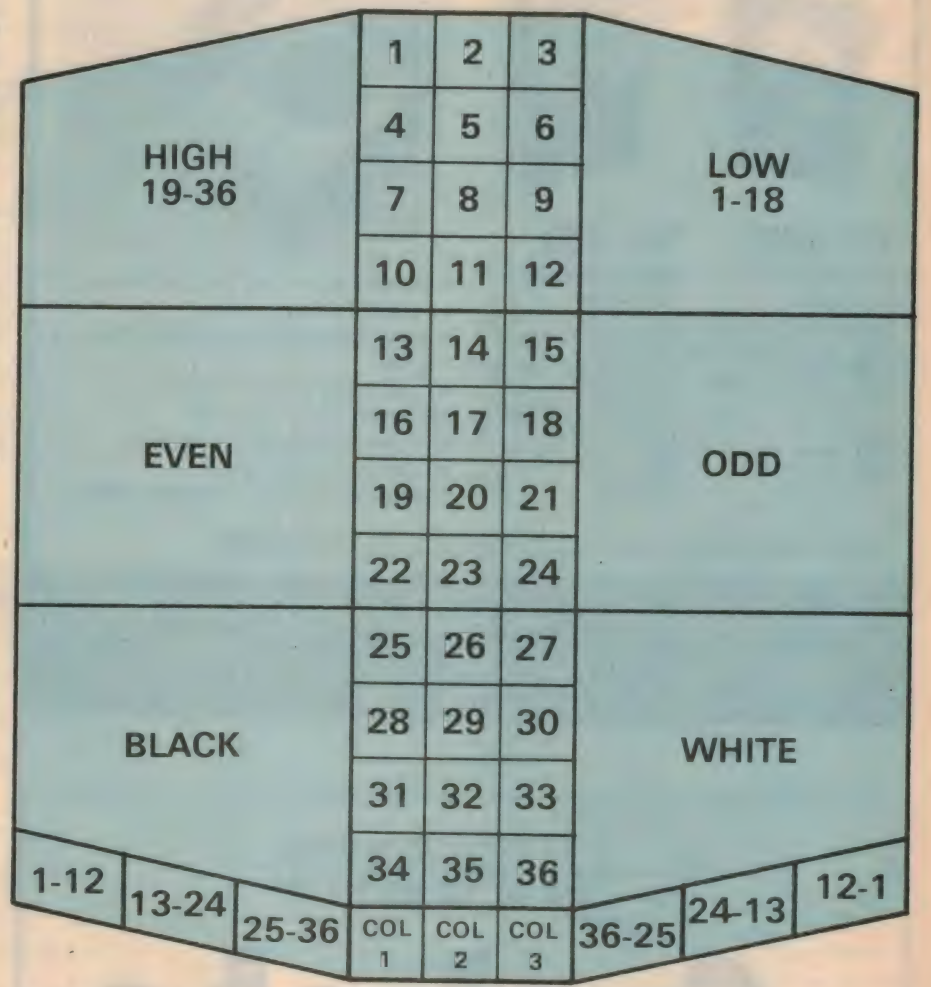
A large copy of the table layout should be made, marked with the numbers as shown. This can be as large as desired. A foolscap size table is suitable for up to six players. The various types of bets, how they are made, and the odds they pay are explained below.

Experienced gamblers may have noticed that we have used a black and white table instead of the more usual black and red one. This was because we found it easier to fabricate a black and white front panel for our Electronic Roulette Wheel. However, there is no reason why a constructor with suitable facilities could not make a red and black panel, as is usually used in casinos. Alternatively, it would be possible to paint or otherwise colour the white sections red. In any case, the table layout should match the front panel of the wheel.

There are six ways of wagering on an even chance. One can bet that the next number will be black or white, even or odd, or high or low. This is done by placing a chip (or chips) on the relevant areas of the table. You may bet on more than one occurrence (e.g., black and odd), and more than one player can bet on the same occurrence.

All these wagers pay even money, i.e., if you wager one chip on the black, and a black number comes up, you receive your original stake back, as well as an extra chip (your winnings). If a white number comes up, you lose your stake.

Odds of 2 to 1 are paid on bets in the nine boxes at the bottom of the table. The centre three boxes represent all the numbers in the columns directly above them. The boxes on either side represent the numbers marked in them. Bets are made by placing chips in the appropriate box. A winning bet is tripled, the winner receiving his original wager plus twice as much.



This diagram should be enlarged and copied onto cardboard. The final size will depend on the number of chips to be used, as well as the number of players.

To receive odds of 35 to 1, you may bet on any single number, by placing your chips in the appropriate box. Odds of 17 to 1 are obtained by betting on two numbers. These numbers must be next to one another on the table, and the bet is made by placing your chips on the dividing line between the two numbers. You win if either number comes up.

To bet on three numbers at once, and receive odds of 11 to 1, place your chips on either side wall of any row. Thus to bet on 13, 14 and 15, place your chips either on the right hand wall of box 15, or the left hand wall of box 13. You will win if either 13, 14 or 15 comes up.

Odds of 8 to 1 are obtained by betting on four numbers at once. This is done by placing your chips on the common corner of four numbers. It is not possible to bet on four numbers which are not adjacent. By placing your chips on the side walls so that they cover two rows, you receive odds of 5 to 1, and win if any of the numbers in either of the rows comes up.

These are the only bets which can be made. A player may make as many bets at one time as he desires, and as many players as wish can bet on any one number or combination of numbers. When all bets have been laid, the banker calls "no more bets", and spins the wheel.

When the wheel stops spinning, the banker calls the winning number, e.g., "ten on the black", and then removes all losing wagers from the table. He then pays out all the winning bets to those fortunate few. No more bets should be laid on the table until all winning bets have been paid. This will avoid confusion, and prevent unscrupulous players from making bets after the result has been decided.

The game can then continue, until either all the players or the banker goes broke.

are eight wire links on the board, which need not be insulated. The three electrolytic capacitors in the power supply must be pigtail types, rather than PCB types, as the headroom is limited.

The series pass transistor for the power supply mounts in one corner of the board. A small "L" shaped heat-sink must be fashioned from aluminium. The transistor is mounted on this with a mica washer and heat-sink compound. The heat-sink is then screwed to the case, with a little heat-sink compound ensuring a reliable thermal bond.

All other components can be soldered directly on the board. We suggest that the ICs are left until last, to minimise the risk of overheating. Remember to check the polarity of critical components, such as diodes and electrolytic capacitors. Use circuit board pins for all external connections to the board.

Once the PCB is completed, it can be mounted on the lid. The transformer is mounted centrally at the other end, as shown in the photographs. The mains cord enters through a grommeted hole, and is then clamped to the lid. File a "U" shaped slot in the edge of the case, so that the lid and bottom may be separated without disturbing the cord clamp.

The earth lead is terminated at a solder lug, screwed to the lid. The active and neutral leads go to the terminal block, and hence to the transformer primary via the power switch. Wrap the terminals of this switch with insulating tape, to eliminate a possible shock hazard.

The LEDs can now be mounted in the case. Use the front panel as a template to drill the required 6.35mm (¼ in.) holes. Care is required, to ensure that the template does not move during drilling.

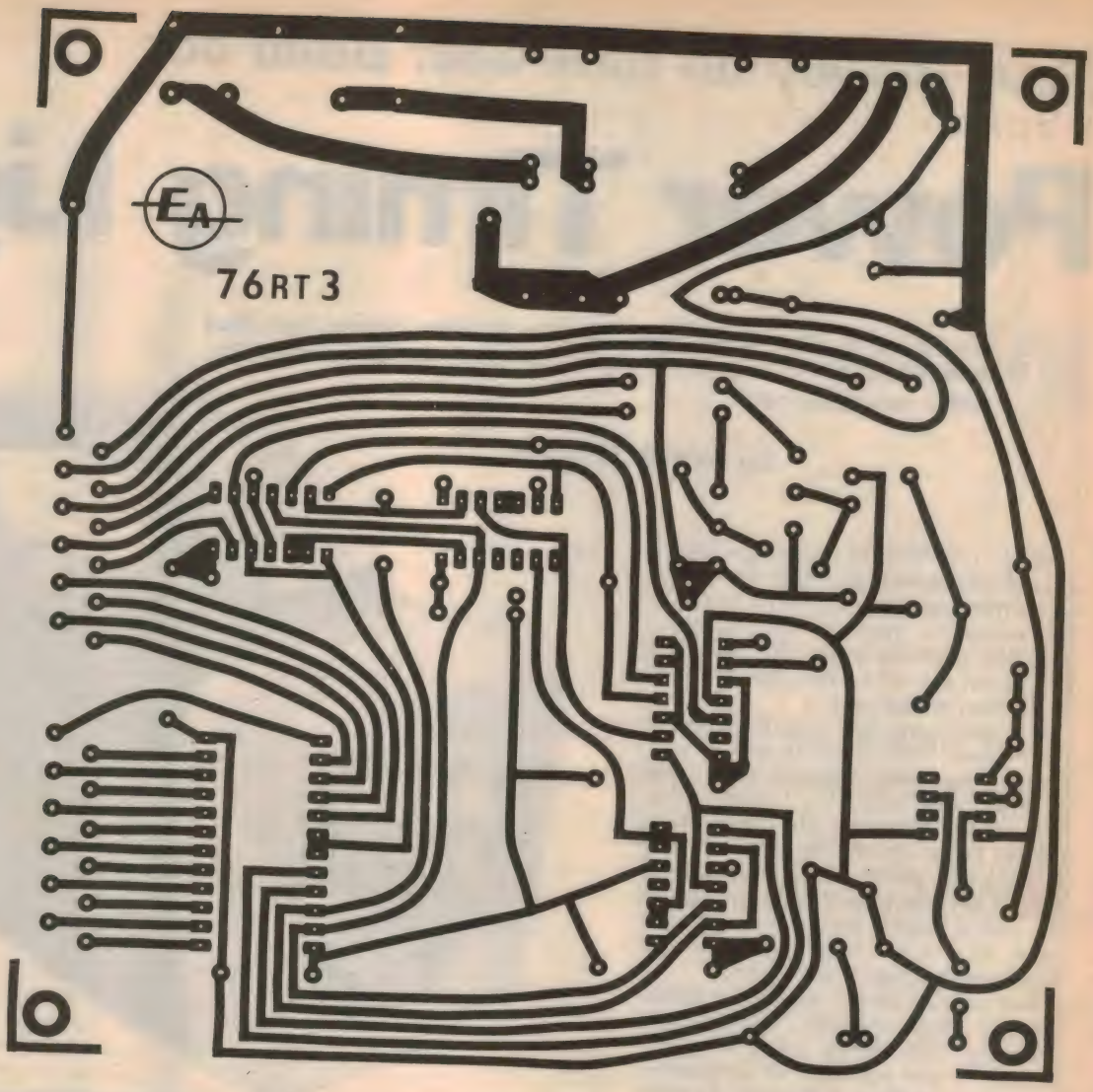
Mount the LEDs in position, using the clips supplied. Orient them so that the anode leads all point radially outwards. This will enable them to be bent as shown in the photograph, so that the "A" and "B" busses can be formed without any additional wiring. There must be eighteen LEDs in each buss.

The cathode leads are bent radially inwards, and short lengths of hook-up wire used to connect diagonally opposite LEDs. Commence wiring from the end of one buss, and work around the circle. Once this has been done, only the wiring to the PCB remains to be completed.

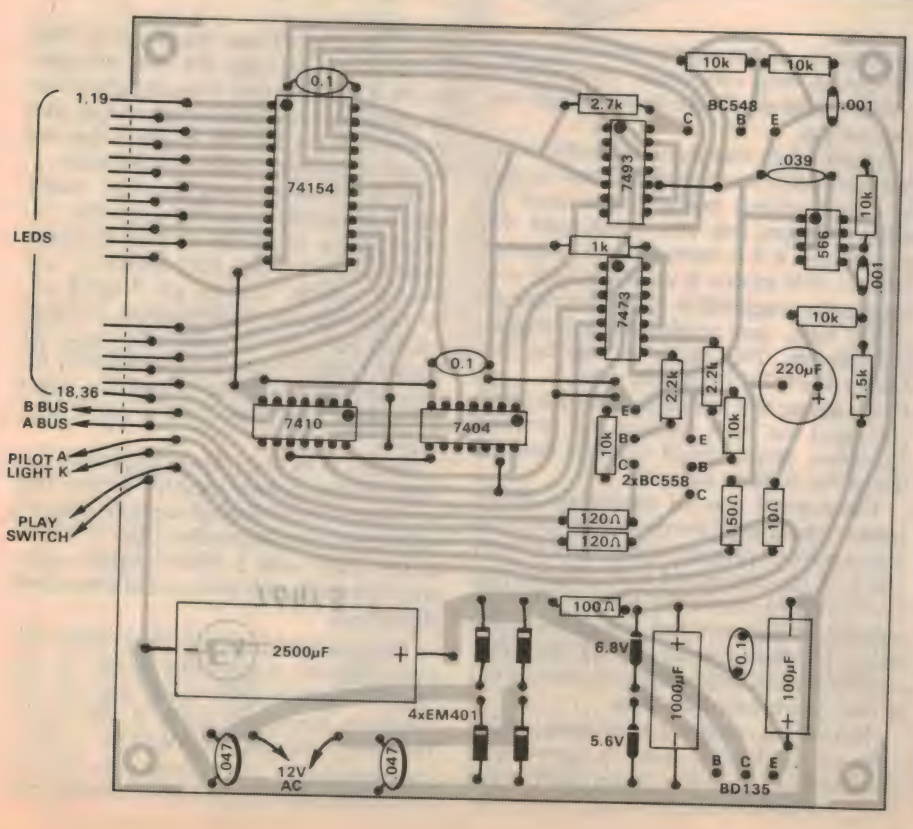
There are 24 connections from the PCB to the LEDs, and these have been grouped in two lots of twelve. We recommend that 12-way rainbow cable is used for these connections, in the interests of neatness and ease of wiring. Two 250mm lengths are required.

The eighteen wires from the PCB labelled "LEDs" must be connected to the eighteen cathode leads. Start at the clockwise end of one buss, and join the cathode of this LED to the first pin of the PCB (i.e. the pin connected to pin 1 of the 74154). Then, working anticlockwise around the LEDs, connect the cathodes sequentially to the circuit board pins. The

Right: The printed board pattern shown full size. As usual, copies of this pattern have been distributed to the board manufacturers and ready made boards should be available from your dealer.



Below: The component layout on the board, shown from the component side. Pay particular attention to the polarity of diodes, electrolytic capacitors, etc., and also to the correct orientation of the ICs.



cathode at the end of the buss should connect to pin 8 of the 7410.

The next two wires from the PCB connect to the two busses. Either wire can be connected to either buss. The next two wires connect to the centre LED. Make sure that the lead marked "anode" is connected to the LED anode. The remaining two wires connect to the PLAY switch.

Construction is now complete, and the machine can be tested. On intitial turn-on, the LEDs should all be flashing sequentially. They may take a little longer than normal to stop, as the 220uF electrolytic capacitor is re-formed.

When the PLAY swith is operated, the LEDs should all appear to be on. As the oscillator slows down, a clockwise rotation will become evident, and eventually only a single LED should be on. If required, the maximum oscillator frequency can be varied by changing the 0.039uF capacitor. The time taken for the oscillator to stop depends on the value of the 220uF capacitor.

You can now commence to play roulette, using your unbiased wheel. For those readers who are unsure of the rules and manner of play, we have prepared a short article and a table layout.

Save money on tune-ups: Build our

Power Timing Light

Power timing lights are a great idea for auto ignition timing but they cost around $60-$80 to buy. Here's one you can build for under $20, using readily available parts.

by ROSS TESTER

While experienced motor mechanics may insist that nothing beats the ear for ignition timing, laymen without "calibrated eardrums" have to rely on more scientific methods to do the job. And the easiest way to achieve this is to use an ignition timing light.

Our last timing light was described in the August 1970 issue. It was a very simple type, using a special neon tube in series with the No. 1 spark plug lead—and nothing else. The energy from the HT pulse ignited the neon as well as the plug, giving a brief flash of red light. If this was placed close enough to the timing marks and pulley, the light from the tube was sufficient to illuminate the marks and notch.

The catch, however, was in the words "placed close enough". Light output from our 1970 timing lights was very limited. It was sufficient in very heavy shadow or at night, but given the level of illumination in the average workshop, it simply wasn't good enough. The author of the 1970 article referred to a previous article using another type of neon in a timing light, and commented how much better the new type of tube was. All I can say is, I would have hated using the earlier one!

Fairly obviously, the answer to the problem was to use a tube having a much higher light output—but the output from any neon tube is limited. In fact, the 1970 tube was about as good as one could hope for in this regard.

Neon tubes were, therefore, not the answer. Our attention then fell on their big brothers, flash tubes (or strobe tubes). Strobe tubes differ from neon tubes in a number of respects, not the least being their gas filling. Neon tubes contain, naturally enough, neon, while strobe tubes contain xenon. The difference is that while neon ionises to a red light, xenon is brilliant white when ionized. Therefore, in terms of illumination, a xenon tube is streets ahead of its neon counterpart.

Another difference is the operating mode of the tube. Neon tubes are generally connected across a voltage source of high enough voltage to break them down immediately. The impedance of the source must be high enough to stop very heavy current flow which would otherwise flow through the ionised gas.

Xenon tubes may be used in this way, but are more usually connected across a voltage source not sufficient itself to ionise the gas, but which will hold the gas ionised if it is ionised by an external source. This source is usually a high voltage pulse coupled in from the outside of the tube, and produced by a trigger transformer. This pulse is usually between 4 and 20 thousand volts.
Once again, the impedance of the supply must be high enough to prevent excessive short circuit current flowing when the tube is ionised.

The normal way of operating strobe tubes is to charge a storage capacitor to the required voltage (which can be from 200 to a few thousand volts, depending on the tube), place the tube across the storage capacitor and trigger it. The capacitor then discharges via the tube, resulting in a flash of light no more than a few micro seconds long.

The length of flash is important, as the life of a strobe tube is generally measured in seconds. If the flash is too long, it doesn't take too long before the tube life is used up—especially at high frequencies. To keep the flash duration down it is important the capacitor/tube circuit has as low an impedance as possible—both for the life of the tube, and to get as brilliant a flash as possible.

For this reason, most types of capacitors are entirely unsuitable for the role of storage capacitor. Electrolytics especially are very, very poor—in fact, they are liable to blow up if used as a storage capacitor (discharge currents exceed 50A). In fact, even the capacitor we are using is not recommended in this role, but for a number of reasons which we will go into later, it is the most practical.

So much for the tube & capacitor—but what of the power supply? As we said, we needed a fairly high voltage (around 300-400V) to operate the tube. What we didn't want was a mains supply—apart from the bulk, the cost would have been quite high.

The power supply in July 1975 CDI immediately suggested itself. It was small, lightweight and, above all, wouldn't break the bank. It also had a feature ideally suited to strobe applications—if the output was shorted (such as happens when the tube fires) the

oscillator simply stops working, and starts operating again when the short is removed.

So it didn't matter that the supply impedance was low—with no output, the tube would simply turn off as soon as the storage capacitor emptied—and the impedance was low enough to ensure the capacitor filled very quickly after each flash.

Thus encouraged, we tried the idea out using a "ratted" CDI unit. By connecting a tube across the storage capacitor and placing a short where the coil would normally go, we were able to make the tube flash exactly as intended.

Then we started thinking about the method of triggering the coil. As we said before, the tube needed a source of EHT at around 4kV to trigger reliably. Most power timing lights use a capacitive pick-up on the No. 1 lead, amplify this and trigger a transformer via an SCR and capacitor—in fact, a mini CDI!

Then the thought occurred that we already had a source of EHT right where we were working—that generated by the ignition itself. Sure, the voltage was a bit higher than needed, but would that matter? A phone call to the importers of the tube soon answered that question in the negative, so my next step was to try this idea out. Unfortunately, we had only one CDI, which I had used for my mock-up. Clearly, we needed another—to work as a CDI!

So I built up another CDI unit (hence my car now has one fitted too!) and connected it up as intended using a coil and simulated points. I connected a piece of hookup wire to the EHT side of the spark gap, with the other end wrapped in a helix around the tube. It worked like a charm, as long as the EHT lead was kept separated.

It appeared, then, the only problem would be insulation between the EHT lead and the rest of the circuit. But everything else appeared to be satisfactory electrically.

Incidentally, to avoid confusion in this article, we are calling all voltages above a few kV EHT. In normal automobile parlance, there are two voltage levels, —LT (low tension, 12V) and HT (high tension, 15kV+). However, when CDI is fitted, and with our timing light there are three voltage levels: LT, 12V; HT 300-400V; and EHT 30kV+.

The next hurdle was the presentation. In the interests of reliability and ease of construction, I wanted everything on a printed circuit board, but hadn't thought much about a case.

Then I thought of the Eveready "Commander" torch, as used (in part) for our "Optomin" project. This is quite reasonably priced, and has a good reflector, suitable for the flash tube.

The printed circuit board I have produced is therefore designed to fit into the Eveready Commander torch, but there are probably other torches which would be as suitable, providing the PCB fits in the case.

Before starting actual construction, take both the PCB and the case, and place the board copper side up on the outside of the bottom of the case. Mark carefully the 3 mounting hole positions. It is much easier to do this before any components are on the board.

Construction can begin with the small components—resistors, capacitors & diodes. Solder them on the board, spacing all resistors about 1 mm or so off the board for air circulation. Next, you can make up the oscillator transformer.

This consists of two FX2242 half cups and a Delrin DT2180 bobbin. In many cases, the bobbin will come with the 375T secondary already wound on. But if you have to do it yourself, and also for information on the primary and feedback windings, refer to the CDI article on page 46 of the July issue.

Note particularly the comments regarding insulation between windings and cleanliness when assembling the cores. To place the transformer on the board, put one long bolt through the board from the underside (with a washer) and place a washer & nut on top. Screw up tightly, but do not force or the halves may crack. Solder the leads into their various positions, followed by the transistors.

While we do not think it is absolutely necessary, we have placed a "U" shaped heatsink under the transistors. When you consider the amount of time taken to time an engine, the transistors should not get too hot, but to ensure 100 per cent reliability the heatsink is included.

Note that because the transistor collectors are connected together, there is no need to use mica washers or insulating bushes. However, a thin smear of heatsink compound won't go astray.

Both transistors must be secured by two screws and nuts to the pattern. As this forms the collector circuit, the bond must be secure electrically, as well as mechanically. We made sure of this by soldering the nuts themselves to the copper pattern, after polishing them with a very fine file. It is sometimes difficult to solder the base and emitter leads close to the body of the transistor, so if this is the case clean them with a razor blade.

Regarding the discharge capacitors, we have chosen 0.47uF 630VW polycarbonate types, connected in parallel as required. The choice is for a number of reasons, bearing in mind what we said before about the role this capacitor has to play. It must have low impedance—these do; it must also have high voltage rating, and again these do. It must as well have a high discharge current rating —these don't, but they are better than many others.

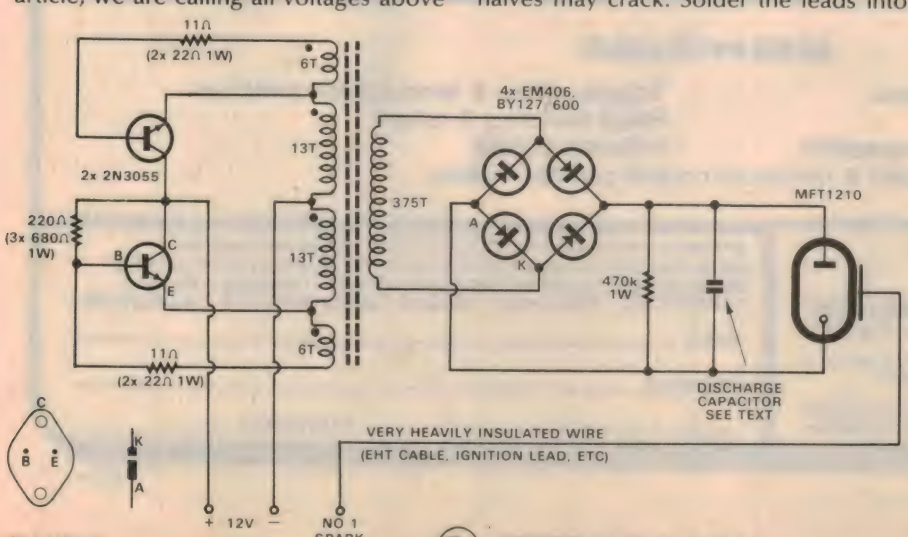
Above all, polycarbonate capacitors are reasonably priced. Unlike most discharge type capacitors, which sell for many dollars, these cost around 75 cents. And it's up to you how many you use. While there is room on the PCB for six (3uF), we used four in our prototype which we considered gave more than adequate light.

The light output of the tube is proportional to the amount of capacitance—but remember, the brighter the light, the shorter the life of the tube. While the tubes may not be too expensive, the trouble lies in getting the old one out.

The reflector of the torch is made of a metallised plastic, and, as such is a conductor. (This is a point to watch with the EHT.) First disassemble the reflector by unscrewing the light and holder, and prising off the backing plate. These can be discarded. The metal collar around the neck of the reflector must be removed, and this can be quite a problem.

It takes quite a bit of "knife & forking" to remove it, but it will come away. Incidentally, the reflector can be removed from its housing to do this, but take care not to touch the reflector material inside. Once on, fingermarks cannot be removed, and polishing, even with a lens cloth, will only mar the surface further.

Readers may recognise the circuit as being almost identical to the CDI published last July. A strobe tube changes it to a timing light.



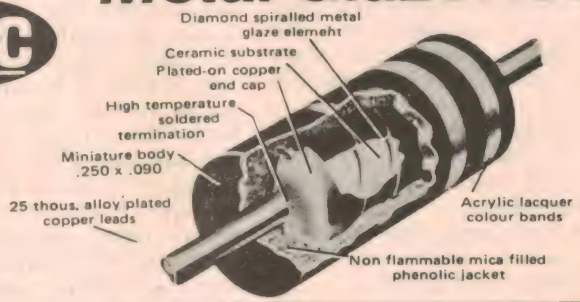
(FILE 7/SC/5)

EA POWER TIMING LIGHT

IRH Components
Means 'Quality Components'

Metal Glaze Resistors

IRC AUSTRALIA



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½ watt @ 70°C .250" x .090"
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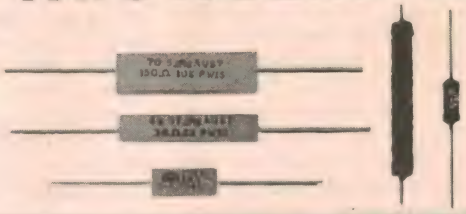
PLUS! Thick Film Reliability
PLUS! Generous Power Safety Factor
PLUS! Fully Insulated Non-flammable Mica Filled Phenolic Jacket
RESULT! THE SAFE ONE

Wire Wound Resistors

IRC AUSTRALIA



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G/7/76

Once the collar is removed, the neck can be shaped to take the tube. This can be done with a file or, because it is plastic, with a soldering iron. Mount the tube horizontally across the reflector so it lies this way when assembled. File (or melt) the plastic so the tube is a firm, but not tight, fit.

The tube is mounted from the front to allow for the exhaust nipple, but before it is mounted a helix of wire must be wound around the tube for the ignition pulse. This is easiest done by using two strands from the length of lead which is going to be the ignition pick-up wire.

This lead has to carry the full EHT from the plugs, and so must have pretty good insulation. Two choices are available: copper cored ignition lead; or TV EHT cable. We used the second. While it may not have high enough ratings, we were unable to make it break down. TV EHT cable should have ratings around 30kV, while the EHT with a CDI might be 40kV or more.

In fact, all wiring within the case should be done with EHT cable, because this increases the insulation between leads where they cross. Thus cable rated at 30kV gives 60kV between leads, and so on. Unfortunately, we could only buy EHT cable in red, so the lead should be marked adequately to show whether it is EHT or the positive or negative supply rails.

For the EHT pick-up lead, cut approx. 1 m (more or less depending on the distance from your No. 1 plug to the timing marks) and strip off the insulation from the last 50 mm. Carefully cut off all the strands except two. Each strand is wound in a 2-turn helix around a leg of the tube so they meet at the top, where they can be twisted together and carefully soldered (take care not to touch the tube with the solder or iron).

To hold the ignition lead in place before glueing, stick some insulation tape right around both leads of the tube and the ignition lead. This may be left in place under the glue.

Now the tube may be glued into place in the reflector. The best material is fast-setting "Araldite" epoxy. This not only holds the tube in place, but also provides insulation between the EHT lead and the reflector. Without the insulation, there will be arc-over.

It may be necessary to provide a number of coats of glue to provide this insulation—hence the reason for using the fast set variety. The whole of the bottom of the tube should be set in epoxy, including the end of the EHT lead. It may be necessary to place tape over the bottom of the reflector opening to stop the Araldite oozing through.

Once the tube assembly has set, solder short lengths (100 mm) of EHT lead to each of the tube leads. These can then be soldered to the PCB. Note that the strobe tube is not polarised.

Both battery leads and the EHT lead are brought out through the rear of the case, the battery leads in line with the handle and the EHT lead right in the middle of the back. Both leads should be knotted inside the case

We make use of the torch switch to turn the inverter on and off. The EHT is left connected all the time (it's very hard to fit a switch rated at 50kV inside a torch case!). Battery leads are of polarised figure 8, one of which (it doesn't matter which) is soldered to one side of the switch. EHT cable is soldered to the other side of the switch and threaded back through the torch case. Make quick, clean joints—otherwise you may distort the plastic with heat and impair switch action.

The other battery lead is joined to another length of EHT cable, and insulated with tape. This is threaded back through the handle also, so that both pieces of EHT cable can then come back through the body of the torch.

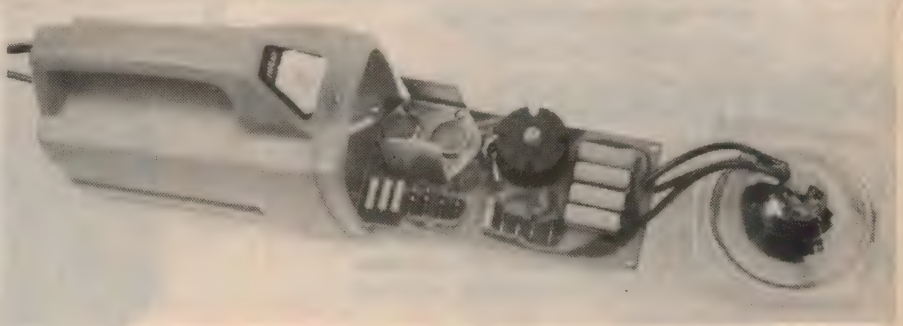
These are then soldered to the copper side of the board in their respective + and – positions. As we said, the leads should be marked to ensure their is no chance of a mix-up between +, – and EHT. If in doubt, check with a multimeter.

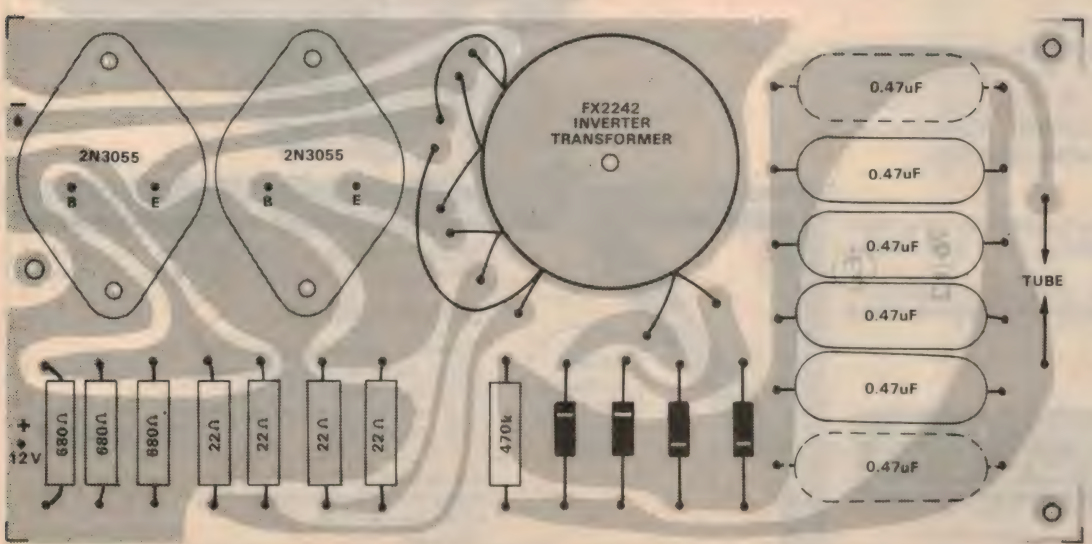
When the leads are soldered in place, the EHT lead can be threaded through its hole from the inside, and pulled through. Don't at this stage, try to place the board inside the case, because operation should be checked first.

First of all, check inverter operation by connecting to a 12V supply (eg, a car battery!) and seeing if the inverter whistles. If not, try swapping the leads to either the emitters or bases (not both). When you have the inverter working, measure the voltage across the storage capacitor. It should be around 300-400V.

Now bare some of the wire at the EHT lead, and connect this to any spark plug lead. With the inverter turned off, start the engine. Before turning the inverter on, check that there are no arc-overs at either end of the EHT lead—ie, at the plug or around the tube. There should be very faint flashes within the tube itself—this is normal.

Now turn the inverter on. The timing





This "strung out" shot shows all components. The PCB slides into the case and is held in by three screws.

Component layout on the PCB, shown actual size to facilitate copying. All resistors are 1W types. Our PCB is fibreglass, but SRBP would do as well.

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light should begin flashing in sympathy with the spark plug to which it is connected. If it does, and there is no evidence of misfiring when the engine is revved to, say, 2000 rpm, the timing light is a "goer" and is ready for final assembly.

If there is evidence of misfiring, or arc-over, there is too much drive to the tube, and some of the helix should be removed. As little as one turn might be all that is necessary.

Carefully slide the board back into the case, taking care not to foul any of the leads as you do. Pull the EHT lead back as you go. With the reflector fully in, there should still be a slight amount of slack in the EHT lead with the knot hard against the rear of the case.

Mounting the board inside the case is a little tricky. The rear screw is very difficult to get to, so is best made a "captive" type by Aralditing a nut to the top of the board. The two front screws are easy to get at, and present no problem.

With the screws in position, the reflector housing may be pushed into position, and locked in place by its screw. The timing light is now finished.

For those contemplating a device of this type, a description of its use is probably quite redundant—but for the sake of the amateur whose interest may be more electronic than mechanical the following information is provided:

The ignition timing is a very small part of the overall tuning process, but it is a very important part for efficient operation of the engine. Before timing, the spark plugs should be checked and, if necessary, re-gapped or replaced, and the distributor points should be re-set or replaced if necessary.

For the novice who is not used to strobe lights near moving machinery, a very wise precaution is to remove the fan belt before attempting timing. At certain engine speeds, the timing light can make the fan appear slow or even stopped, with risk of injury if mistaken.

The ignition timing is normally referenced to No. 1 cylinder—however, there are exceptions, so check the workshop manual. The timing mark is normally located on the crankshaft pulley, but it may be on the flywheel with an inspection plate to undo before timing can proceed. The timing mark will coincide with the reference marker or scale at the correct point in the piston cycle.

The exact point will vary from vehicle to vehicle and even model to model, but will normally be from about 4° to about 10° before top dead centre (BTDC). Some cars may have a scale marked on them, with 0° as TDC, and a range of degree marks each side. Others may have the same scale, but with a mark at the timing point (e.g. –8°). Consult the workshop manual, or your local garage, who will be able to show you the mark or tell you the correct point.

The timing is altered by rotating the body of the distributor. You will find a bolt holding the distributor tight in position—loosen this slightly and disconnect the vacuum advance line before starting timing.

Timing should be conducted with the engine running at idling speed. If you have no tachometer, adjust the idling screw on the carburettor up or down until the engine just runs smoothly.

Connect the + and – leads of the timing light to the battery of the car (check that light is operating by briefly switching on & listening for the whistle) and then connect the HT lead to the top of No. 1 plug or to No. 1 lead at the distributor.

Then hold the timing light so it plays on the area of the timing mark and (preferably have someone else) start the engine. The lamp will flash and the timing mark appear stationary somewhere near the reference mark. Rotate the distributor until the timing mark and the reference mark coincide.

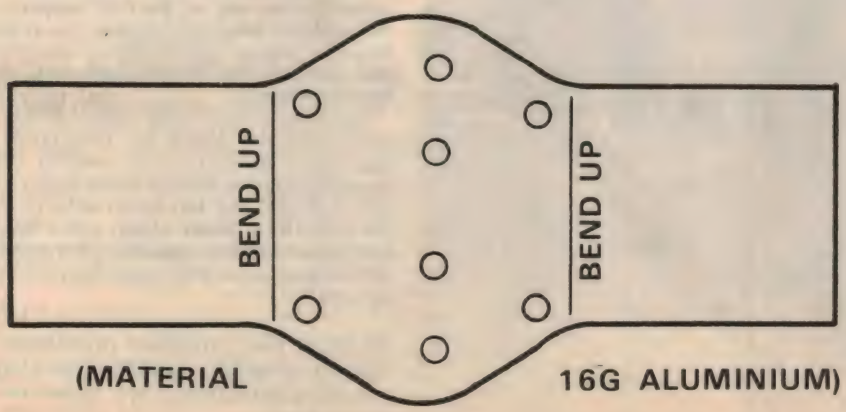
Once the timing is completed, lock the distributor back into position. Reconnect the vacuum advance line, and check the timing again. As the engine speed is increased the timing mark will appear to move in the opposite direction to the rotating shaft.

And there you have it. A timing light which will help keep your car running smoothly, at less than a quarter of the cost of a commercial model.

PARTS REQUIRED

1 "Commander" torch, modified as described
1 PC board, code 76/t12
1 pair FX2242 ferrite cup cores
1 DT2180 Delrin former
2 2N3055 silicon NPN power transistors
4 EM406, BY127/600 silicon power diodes
1 MFT1210 flashtube
CAPACITORS
2, 4 or 6 0.47/630VW polycarbonate (see text)
RESISTORS (5 or 10%, 1W)
1 470k, 3 680 ohms, 4 22 ohms
MISCELLANEOUS
Double tough enamelled copper wire (26, 28 and 32B&S), spaghetti sleeving, epoxy adhesive, EHT cable as required, 23/.0076 hookup wire as required, 3 nuts & bolts, 16 aluminium for heatsink, solder, silicone grease, etc. Note: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings in this case must not be used.

This full size drawing of the transistor heatsink can be used as a template. Hole sizes are not critical—ours were ⅛in. A smear of silicone grease between the transistor and heatsink will improve thermal conductivity.



Modulator & power supply for the novice transmitter

Here is the second article describing our Novice Transmitter, and it gives details of the power supply and modulator unit. While designed to go with the transmitter described last month, it would be equally suitable for use with other small transmitters.

by IAN POGSON

Last month we described the transmitter proper of our new 3.5MHz Novice Transmitter and we come now to the power supply, with the speech amplifier and modulator integrated on the same chassis. Those of you who may have built the transmitter already, will find this second part somewhat easier to make.

Before proceeding with other aspects of this part of the project, let us have a look at the circuit. The speech amplifier is split into two stages, each using one half of a 12AX7 twin triode. The first half takes its input from the microphone and to make the input as versatile as possible with respect to microphone types, the grid resistor has been kept to a high value of 2.7M. This means that crystal, ceramic, or dynamic microphones could be used. Bias for the valve is obtained with a 3.3k cathode resistor, bypassed with a 10uF electrolytic capacitor. The plate load is a 220k resistor.

Output from the plate of the first stage is fed via a .0068uF coupling capacitor to a 470k potentiometer, which serves as the audio level control and in turn sets the modulation depth. The rotor of the potentiometer feeds into the grid of the second stage, with bias and plate load conditions the same as the first stage. HT supply to both stages is decoupled via a 10k resistor and 8uF 300VW electrolytic capacitor.

Output from the second stage is fed via another .0068uF coupling capacitor to the grid of the 6BQ5 modulator valve. Cathode bias is obtained with a 180 ohm 1W resistor bypassed with a 10uF capacitor. The plate load is one winding of the modulation transformer and the screen grid is supplied directly from the HT line. The .001uF capacitor shunting the transformer winding restricts the audio high frequency response. Low frequency response is restricted by the two coupling capacitors and the three cathode bias resistor bypass capacitors.

The secondary winding of the modulation transformer has one end connected to the HT side of the primary winding. The HT supply is fed to this common point via one pole of a DPDT toggle switch. This switch selects either the "Phone" or "CW" mode of transmission. The other end of the secondary winding is routed to the modulated RF amplifier in the transmitter assembly, via pin 5 on the outlet socket. It may also be seen that there is an ordinary power diode connected in series with the secondary circuit just referred to and that there is a connection from the cathode of the diode to the mode switch. This arrangement is adopted to avoid transients being developed across the secondary of the modulation transformer when the transmitter is keyed for CW.

The other pole of the mode switch runs via pin 8 of the socket and connects to a set of relay contacts on the transmitter chassis. Pin 3 of the socket is the HT line to the crystal oscillator of the transmitter, while pins 2 and 7 carry the 6.3V AC heater supplies to the transmitter valves.

The power supply is very simple but adequate for the job. The high tension voltage is derived from the transformer secondary winding in a full wave voltage doubler arrangement and with a current rating of 125mA. There are two 6.3V heater windings, each rated at 3A, one being used for the RF part of the transmitter and the other for the audio section. To reduce the hum level to an economical minimum, a 47uF electrolytic capacitor is added across the HT line. Also, a bleed consisting of three 15k 1W resistors in series is added across the HT line. This discharges the capacitors after switching off, thus avoiding the possibility of electric shock from storage.

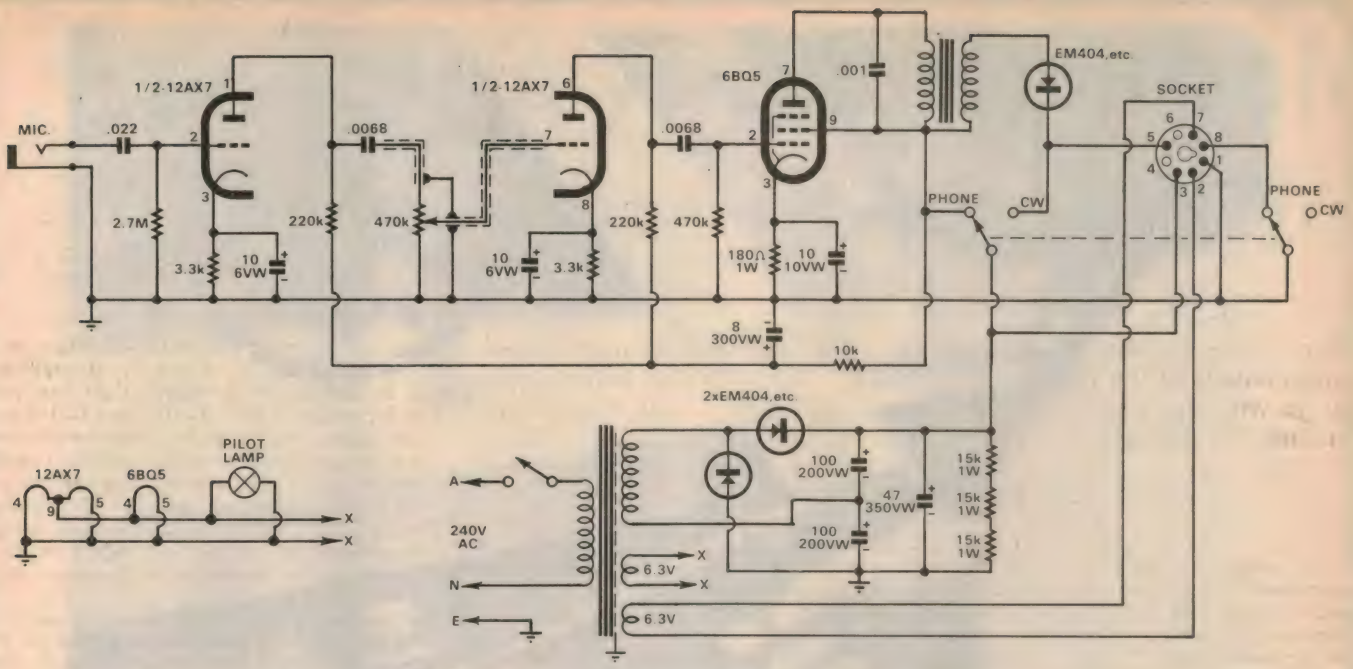
All of the components used on this unit are fairly straightforward and no difficulty should be experienced in this regard. However, a few comments on some of the components used may be useful.

Resistors and capacitors are commonly used types and there should be no problems here. The toggle switches, in common with those used on the RF section described last month, are made by McMurdo and this particular design is ideal for our purpose. The knob is the same as used on the RF section.

The indicator lamp is one which we have used before on a number of projects and should be readily available. It may be seen that we have specified a lamp rated at 14V. This is used across one of the 6.3V supplies and obviously the lamp will not glow very brightly. However, it gives sufficient light as an indicator and it should last almost indefinitely under these conditions.

The power transformer which we used is type PVD104, made by Ferguson. An equivalent transformer in another brand should be all right. Indeed, if you have a transformer in your junk box which will give about 275 volts DC at about 125mA and it has two 6.3V heater windings capable of delivering the current required in each case, then this could be used.

At left is the completed prototype, designed around a simple dish-shaped chassis. Circuit details are shown on the facing page.



3.5MHz NOVICE TRANSMITTER
(MODULATOR AND POWER SUPPLY)

The modulation transformer which we used is a power transformer. It is also one made by Ferguson, type PF201. It has two windings of interest—the usual 240V primary winding and a secondary winding giving 225V each side of a centre tap. As we will see in a moment, these windings can be used such that they give quite a good impedance match between the modulator (6BQ5) and the modulated amplifier (6CM5).

To find the load which the modulated amplifier presents to the modulator, we take the plate supply voltage and divide it by the combined plate and screen current of the valve. We will consider the voltage between the supply line and the cathode of the modulated amplifier to be 250V and the combined plate and screen current to be 42mA. Now 250 x 1000/42 results in a load of near enough to 6000 ohms. On consulting the characteristics and operating conditions for the 6BQ5 modulator valve, we find that the required load is 5200 ohms. Under some conditions this amount of mismatch may be tolerated but we do not have much audio power to spare, so we must take steps to get a closer match.

The circuit shows that each of these valves is fed through a separate winding on the modulation transformer. By manipulating the transformer turns ratio between the two windings, we can obtain the proper match. The impedance ratio is 6000/5200, which is equal to 1.15. Now the turns ratio is proportional to the square root of the impedance ratio, and the square root of 1.15 is just about 1.07.

The voltage ratio given for the windings of a transformer is proportional to their turns ratio. Let us see what our transformer can offer. The ratio of 240/225 is just a little under 1.07—just about as close as we could possibly hope for. This means then, that if we use the 240V winding to feed the modulated amplifier and one of the 225V windings for the feed to the 6BQ5, we will have achieved our matching objective.

The example just given for our particular purpose shows how the calculation is made and if you have the need to find the transformer ratio for another set of circumstances, then it is only necessary to follow the example given.

Before leaving the subject of modulation transformers and matching, there is an old trick which may be used where circumstances permit. In days gone by, there were many power transformers about which had a centre-tapped secondary, not unlike the one which we have used. Instead of using the primary winding, this is left unused and both halves of the centre-tapped secondary winding are used. The centre-tap would be connected to the common high tension power supply and one side feeds the modulator valve and the other side feeds the modulated amplifier.

This idea may be used where the impedance ratio required is exactly one, or very close to it, or in cases where a certain amount of mismatch could be tolerated. The idea also has the advantage that the two lots of DC flowing through the windings are such that their magnetic effects cancel in the core, or very nearly so.

The chassis in blank form is available from at least some components stores and if the correct size is not readily available to you, then one close to the wanted size should not be difficult to come by. We drilled and punched the holes in the chassis for the prototype.

As may be seen from the photographs, we have not fitted the modulator and power supply into a case as was done for the transmitter. There is no particular need for a case for the modulator, whereas the transmitter must be covered for safety reasons, as well as for shielding against unwanted radiation directly from the transmitter. However, if you wish to fit the modulator into a case to match the transmitter, then there is no reason why this should not be done.

Construction of this unit is fairly straightforward but there are some points which could be discussed and which should make the job that much easier.

We will assume that you have a ready drilled chassis and all the components. It is always a good idea to assemble the small and light components first. These include the valve sockets, microphone jack, indicator lamp, volume control, switches, electrolytic capacitors and mains terminating strip.

Before attempting to fix the two transformers, make sure that you have the rubber grommets in place. When the transformers are screwed in place, all the flying leads will be left sticking through the holes and vertical to the chassis. The next job is to get rid of these leads as soon as possible. As may be seen from the underneath picture, we used a miniature tag strip with 16 pairs of tags in about the middle of the chassis. All of the tags are not used. We fitted this tag strip mainly to terminate the transformer flying leads. In addition to terminating these leads, we also mounted the three 15k 1W resistors, the three EM404 silicon diodes and the 47uF electrolytic capacitor. This is not a complex job and so we are leaving it to the individual to wire it as he sees fit.

Before leaving this board, there is one point which we observed and which we think it would be wise to include in your wiring. We brought all earth connections involving the power supply to one tag on the board, near the electrolytics. This point is later wired to another point on the chassis and near the microphone input. The mains earth lead is connected to the chassis to a solder lug under one of the electrolytic fixing screws.

Having disposed of the transformer flying leads and having done the rest of the wiring on the terminating board, we are now in a position to extend the terminated leads to their destination. These include heater wiring, both to the audio valves on the chassis and the other heater circuit to pins 2 and 7 on the octal outlet socket. The high voltage supply and modulation transformer wiring completes this part of the job.

By now you may have already done the heater wiring to the two valves. This circuit will still be floating and it should now be earthed to a solder lug under one of the valve socket screws for the 12AX7. The centre spigot for both sockets should also be earthed, that for the 6BQ5 to another lug at its socket.

Most of the components for the two valves are mounted on a piece of miniature tag board with 15 pairs of tags. All of the tags are not used but we made the strip long enough so that components could be placed to keep

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leads as short as possible. No drawing has been made for this board either but to help the builder, this is the order of the components from the input end. 2.7M resistor, 10uF capacitor with its 2.2k resistor underneath, 220k resistor, .0068uF capacitor, 10uF capacitor with its 2.2k resistor underneath, 220k resistor, .0068uF capacitor, 470k resistor, two blanks, 10uF capacitor, 180 ohm resistor, .001uF capacitor, 8uF capacitor and 10k resistor.

With the components mounted, interconnecting wiring is done. We kept the components to be earthed such that all items for the 6BQ5 are kept together and an earth lead run direct to the earth lug on the 12AX7 valve socket. Similarly, all items to be earthed and associated with the 12AX7 were connected together and another separate lead run to the common earth lug. Other leads are run to the respective valve socket pins. The two leads from the volume control are run in light coaxial cable. The braid of each cable is connected to the earth lug on the volume control and the braid is cut short and not terminated at the other end. A lead from the volume control earth lug is run to the common earth point. Similarly, the earth lug on the microphone input socket is earthed to the common point.

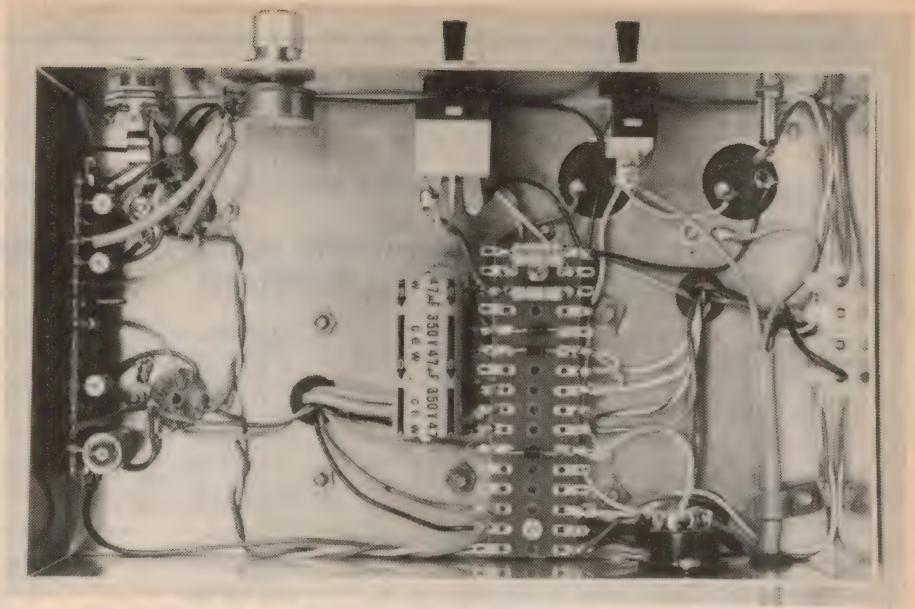
You may notice that we have used a .022uF coupling capacitor between the microphone input socket and the grid of the valve. This is not strictly necessary and under most circumstances it may be omitted. It may also be noted that we have not taken any precautions against RF getting into the audio amplifier. This was found not to be necessary on the prototype. However, if you wish, or find it necessary, a small capacitor of 100pF or so may be shunted across the 2.7M resistor. A 47k resistor may also be connected in series with the lead between the microphone and the grid of the valve. Another method which is sometimes used, is to slip a ferrite bead over the lead right at the valve grid pin.

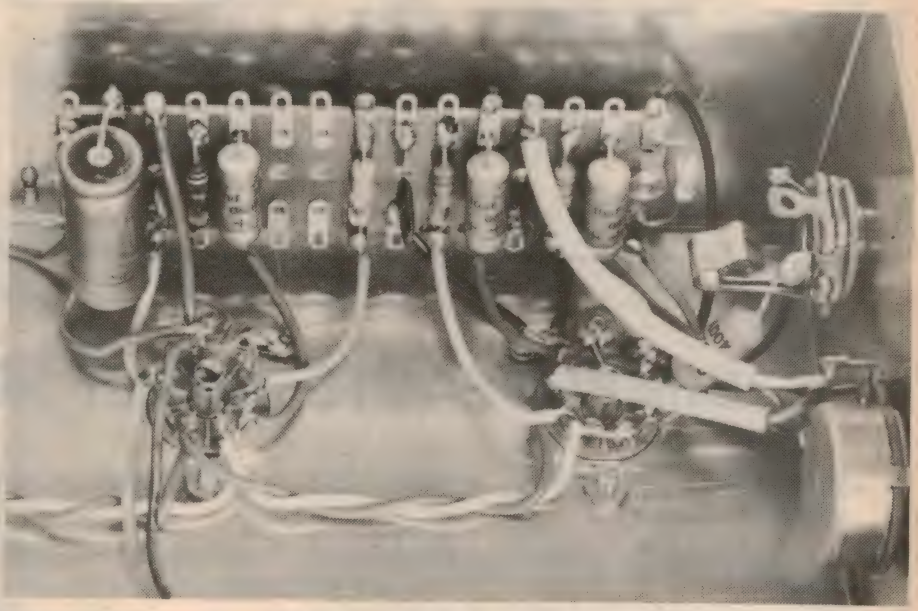
Having completed the wiring, before proceeding with tests, it is essential to make a thorough check to make sure that there are no errors or omissions in the wiring. Care should be taken to make sure that all pin connections on valve sockets are correct. The polarity of diodes and electrolytics should also be checked.

We are now in a position to test the complete transmitter and put it into operation. While there may be many ways of going about this, I will run through a procedure which should make the task quite straightforward.

The transmitter should be left out of its case for testing and the valves may be left out of the modulator chassis for the initial stages. Connect up the cable between the units and connect a dummy load to the transmitter output, equal to the characteristic impedance of the feedline which you intend to use e.g., 50 or 75 ohms. Set the "power" and "net" switches to the off position and the other two switches to "receive" and "phone". The audio gain should be turned off, the meter switch set to "grid" and the "tune" and "load" capacitors set right in. The crystal which you intend to use should be plugged in.

Break the HT lead feeding the plate and screen of the 6CM5 valve and make sure that the lead is kept out of harm's way. Turn on the power switch and wait for about half a minute for the valves to warm up. Now throw the switch to "send". The relay should operate and you should get a small reading of grid current. Adjust the slug in the oscillator plate coil for maximum grid current reading. This should be about 1.5mA. Switch back to "receive" and switch off the power; then connect up the HT lead which you just disconnected.



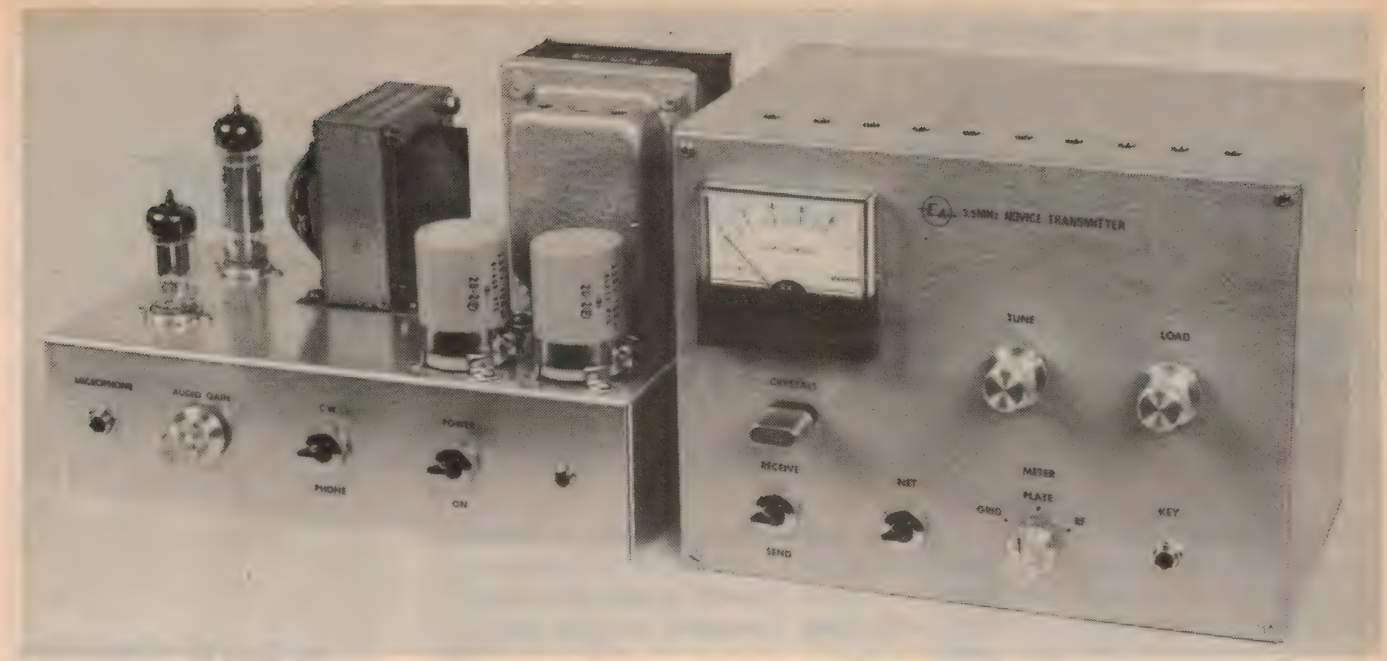


View at top shows the simple nature of the under-the-chassis layout. Below is a detailed view of the tagboard mounted on one side of the chassis, together with its associated wiring.

Switch on again and wait for warm-up. Set the neutralising capacitor to minimum capacitance. Set the meter switch to "plate", and switch to "send". The plate current will rise to a high value of about 80mA or so and this condition should not be allowed to persist. Carefully rotate the "tune" control until a dip is obtained in the plate current reading. Tune for maximum dip. This should be somewhat less than 40mA. Now rotate the "load" control which will cause the plate current to rise again. Stop at 40mA and touch up the "tune" control for dip again. It may not have altered very much. If you are unable to load up to 40mA then the .0018uF capacitor needs to be reduced. If you cannot get down to 40mA then the capacitor will have to be increased.

You now have the transmitter running with about 10 watts input to the final, which is the power authorised. We will come back to this a little later on to make more precise adjustments to the HT voltage and the meter reading accuracy. Meanwhile, we will neutralise the final and this is an interesting operation. If you have a wavemeter, or a GDO which can be used as a wavemeter, then this can be used as an aid to neutralising. If you do not have one, then we can do without it.

Switch to "receive" and switch off the power. Again disconnect the HT line to the plate and screen of the final as before. Do not touch the "tune" or "load" settings. Switch on again and after warm-up, switch to "send". Bring the coil of the wavemeter near to the final tank coil and adjust the wavemeter to the frequency of the crystal, such that an indication is given on the wavemeter. Adjust the neutralising capacitor for minimum indication on the wavemeter. Now slightly adjust the "tune" control for an increase in the wavemeter reading and adjust the neutralising capacitor for a minimum reading. Repeat this process until the minimum possible reading has been obtained on the wavemeter.



The modulator and power supply unit together with the transmitter described last month.

At this point the final is neutralised for all practical purposes but this can be checked and indeed, there is a second method which may be used by those builders who do not have a wavemeter.

To check the latest adjustment for correct neutralisation, or to actually carry out the process from the beginning, the following procedure is suggested. Before starting however, the HT lead to the final which was disconnected must be restored.

Switch on and tune for a precise dip in plate current as previously described. Now set the meter switch to "grid". To carry out this procedure it will be necessary to switch the meter from "grid" to "plate" as required. With the final correctly dipped, carefully watch the grid current reading and slowly detune the "tune" control in one direction. The grid current should fall. Now dip the plate current again and repeat the procedure, this time turning the "tune" control in the opposite direction. If neutralising is "spot on", the grid current will fall again, and you have a properly neutralised transmitter.

Should the grid current rise and then fall as you slowly tune away from resonance in one direction, then the stage is not properly neutralised and the neutralising capacitor should be given a slight adjustment in one direction. If a subsequent check shows that the situation is worse, then you have moved the neutralising capacitor the wrong way. Pursue this course until the grid current falls on both sides of resonance.

If you have not made any preliminary neutralising adjustments using a GDO as previously discussed, then follow the subsequent procedure just described. The only difference this time is the possibility that the neutralising capacitor will have to be adjusted by a greater amount than if you had made the preliminary adjustment.

Having neutralised the transmitter, before we go on to the modulator, we hinted that the meter plate current readings may be somewhat in error. This may be checked by making a comparison with a multimeter of known accuracy. The HT line will have to be broken say between the 100 ohm resistor and the 22k screen resistor and the multimeter inserted in series with the line. With the transmitter switched on, the multimeter should indicate approximately 40mA and this should be compared with the reading on the transmitter meter. If the reading is low, then the 10k resistor must be shunted with a high value of resistor such that the reading is correct. On the prototype, we shunted the 10k resistor with a 100k resistor. If the meter reads high, then the 10k resistor will need to be increased.

So far, we have not checked the HT voltage. Ideally, this should be about 265 to 270V. If not, and the transformer has some taps which will allow you to effect a voltage adjustment, then we suggest that you aim for this voltage. If your transformer does not allow for any adjustment, then the voltage should be taken between the HT point and the cathode of the 6CM5, with the transmitter properly adjusted. The plate current of 40mA which we quote is on the assumption that the effective plate voltage is 250. If it deviates in either direction from this value, then the plate current should be adjusted accordingly, to give an input power to the plate of 10 watts.

With the transmitter adjusted, the valves may now be fitted to the modulator chassis. Switch on and bring up the transmitter and still with the dummy load attached, tune into the signal on a receiver, preferably fitted with a pair of headphones. Turn the volume control off, plug in the microphone and slowly advance the volume control while speaking into the microphone. Your voice should be heard in the headphones. Continue to advance the volume control until the plate current meter on the transmitter starts to kick and then back off a little. This should give about the right setting for the audio level.

If you have a CRO or some other means of checking modulation, then it is a good idea to check for depth of modulation. This done, and with your Novice licence in one hand, pull out the cable to the dummy load and plug in the aerial feedline with the other hand. Switch on the transmitter. It may be necessary to re-adjust the "load" and "tune" controls a little to get the right value of plate current again. You are now "on the air", and I wish you good DX!

LIST OF COMPONENT PARTS

1 Chassis, 10in x 6in x 2½in
1 Transformer, primary 240V, secondaries 120V, tapped 110V, 100V at 125mA, 6.3V at 3A, 6.3V at 3A. PVD104 or similar
1 Transformer, primary 240V, secondary 225V-CT-225V. PF201 or similar (see text)
1 Switch, SPST, McMurdo
1 Switch, DPDT, McMurdo
1 Jack socket, 6.4mm
1 Indicator lamp, 14V type BFB-6G, Rodan
1 Knob, label etc
1 4-way mains terminal strip
1 Miniature tag board, 16 prs tags
1 Miniature tag board, 15 prs tags
2 Valve sockets, 9-pin miniature
1 Valve socket, octal
4 Rubber grommets
1 Valve, 12AX7
1 Valve, 6BQ5
3 Silicon diodes, EM404 or similar

RESISTORS (½W unless stated otherwise)

1 180 ohms 1W	*2 220k*
2 3.3k	*1 470k*
1 10k	*1 470k log pot*
3 15k 1W	*1 2.7M*

CAPACITORS
1 .001uF 630V ceramic
2 .0068uF 400V polycarbonate
1 .022uF 400V polycarbonate
1 8uF 300VW electrolytic
2 10uF 6VW electrolytics
1 10uF 10VW electrolytic
1 47uF 350VW electrolytic
2 100uF 200VW electrolytics

MISCELLANEOUS
Hookup wire, solder, solder lugs, screws, nuts, 3-core power flex, 3-pin plug, cable clamp, 15cm shielded or light coaxial cable.

Protect your home from intruders:

Low-cost alarm sensor is easy to install

Here is a simple light-activated alarm sensor, with applications in home burglar alarm systems. It is intended to be concealed in wardrobes, cupboards and similar dark places, and will provide a second line of defence, by detecting intruders who have managed to gain entry without setting off the main alarm.

by DAVID EDWARDS

As anybody who has fitted, or contemplated fitting, a burglar alarm will know, it is very expensive to fit all points of entry to a house with intruder detection sensors. Indeed, sometimes it is virtually impossible to cover all possible entry points. One place that springs immediately to mind is the roof: a common means of entering a house or apartment is to get into the roof, and then to cut through the ceiling.

One solution to this problem is to form a second line of defence. Assuming that most obvious entry points, such as ground floor windows and doors have been covered, but that these have been defeated, then there is a distinct possibility that the intruder will relax his guard. A second set of sensors, placed in appropriate locations, may well succeed in triggering the alarm system.

Once entry has been gained, the house will usually be ransacked. This entails emptying the contents of cupboards and wardrobes.

When this occurs in daylight hours, the light level in the cupboard or wardrobe will increase. Likewise at night, unless the intruder is blind and does not turn on the room lights or use a torch.

A light dependent resistor, or LDR, placed in a suitable location, will react to this change in light level. This can be used to trigger an alarm.

The circuit of the sensor we have developed, based on an idea by Mr. Tony Beekman, of 13 Emu Street, Enfield, NSW 2136, is shown in Fig. 1. The sensor is used in conjunction with the alarm unit, shown in Fig. 2.

The LDR and the 10k resistor form a voltage divider across the two wires supplying 12V DC to the sensor. The output from this divider is connected to the gate of a silicon controlled rectifier (SCR) by a 33uF tantalum capacitor. The 1k resistor connected between the gate and the cathode of the SCR serves to stabilise its operation.

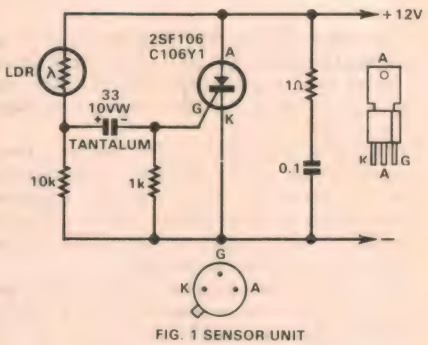


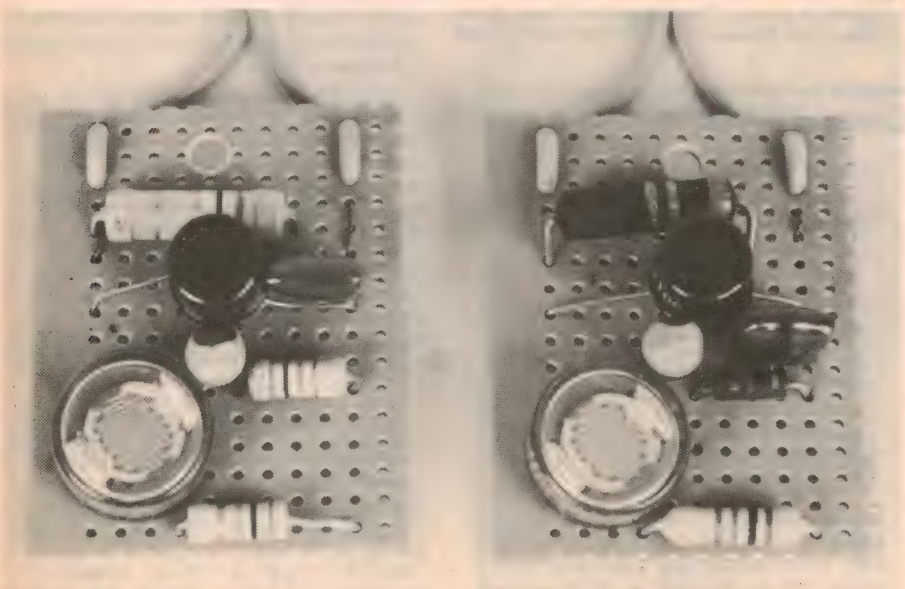
FIG. 1 SENSOR UNIT

The circuit diagram of the sensor unit shows the relatively few parts used.

The SCR is connected directly across the supply lines. The load for the anode circuit is provided by a 12V relay, which is connected in series with the positive lead at the alarm unit.

Operation of the two units is as follows: when the LDR is in the dark, it has a high resistance, and the voltage on the positive end of the capacitor is low. The SCR is turned off. A sudden increase in the light applied to the LDR generates a corresponding increase in the voltage applied to the capacitor. This increase is transmitted to the gate of the SCR, firing it.

When the SCR fires, current is drawn through the relay, energising it, and setting off the alarm connected to the contacts. The SCR will remain triggered irrespective of the light applied to the LDR. It can only be reset by momentarily interrupting the current through it, using the reset switch.



View showing two of the sensor units made up on Veroboard. Units are electrically identical, in spite of minor differences in physical layout.

By using a capacitor in the gate circuit of the SCR, the sensor becomes insensitive to slow changes in light intensity. This will reduce the incidence of false triggering due to such things as changes in ambient light. If required, the capacitor can be deleted, and the LDR connected directly to the gate of the SCR.

In the untriggered state, current consumption of the sensor unit is very small. The leakage current of the SCR is of the order of 1uA, while the current drawn by the LDR, which depends on the amount of light illuminating it, is normally about 10uA. This means that it is possible to use several sensor units in parallel with the one alarm unit. This can be triggered by any one sensor, the remaining sensors then being disabled.

Current consumption in the triggered state is principally determined by the relay, and any alarm bells used.

With some installations, where the distances between sensor units and the alarm unit are large, trouble may be experienced with false triggering due to

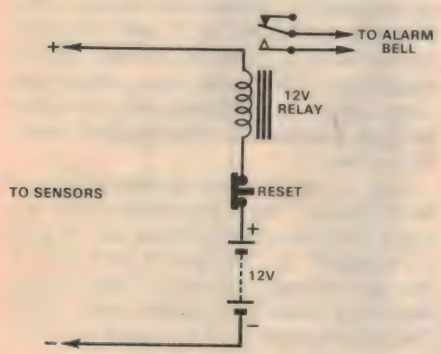


FIG. 2 ALARM UNIT

Any number of sensor units can be connected to this simple alarm circuit.

transients induced onto the lines. The RC network connected across the SCR will eliminate almost all of this, as well as limiting the rate of rise of the anode/cathode voltage.

The components for the sensor units are conveniently mounted on small pieces of tagstrip or Veroboard, as shown in the photograph. Connect them to the alarm unit using either bell-wire or twin-lead. The leads should be colour-coded, and kept well away from any mains wiring.

Mount the sensor units in wardrobes and cupboards, concealing them as much as possible while still allowing light to reach the LDR when the doors are opened. Remember that the leads to the alarm unit must be concealed, or it will be possible to defeat the sensor by cutting the leads.

The alarm unit can be mounted in any convenient place, and could form part of another alarm system. As the unit has very low current drain, it is possible to use dry batteries as the power source. Their life should equal the shelf-life, provided the alarm is not triggered too often.

Build your own electrostatic loudspeaker

Electrostatic speakers have been highly regarded by audio enthusiasts, but also regarded as financially out of reach for most. This article tells how to make an electrostatic speaker for very little cash outlay and a following article describes amplifiers and an active crossover network to drive it. The latter circuit is of interest in its own right.

by A. A. RENDLE*

Electrostatic loudspeakers have been around for quite a while, now. The "Quad", full range system has been in production for almost 20 years. Despite this, electrostatic speakers have been slow getting off the ground. Even today, there are only a handful on the market, and they are all fairly dear. This makes it difficult for an enthusiast with an ordinary size pocket to find out at first hand whether electrostatic speakers are all they are cracked up to be.

The enthusiasts for electrostatic speakers claim that, even acknowledging the recent improvements in moving coil design (dome tweeters, etc.), a top quality electrostatic speaker system is still the one to beat for smooth frequency response, low distortion, and, especially, superb transient response.

To overcome the expense it seemed worth having a go at building an electrostatic unit from scratch. A full range system is rather a tall order, as the bass units are on the large size. A reasonable compromise is to use an electrostatic unit for the mid and treble ranges, allied to a conventional moving coil bass. There are a number of commercial units like this now, e.g., the Bowers and Wilkins DM 70, and the Amcron ES-26.

After a good deal of experimenting, and research into materials, it turns out that making a unit to cover the 500Hz-20kHz range really is a practicable proposition, in a modestly equipped home workshop. Agreed, a certain amount of time, effort, and persistence is needed, but not much in the way of dollars and cents. Those of you who stay with us will agree that the final results fully repay any effort involved.

There are plenty of articles on the theory of electrostatic loudspeakers, but literature on practical methods of construction, choice of materials, etc., is very sparse. To redress the balance a little, we will be concentrating on the practical side here. Some references are given at the end, for those who would like to look a little further into the theory.

The essential elements of an electrostatic loudspeaker are shown in Fig. 1. The basic structure is simplicity itself: a thin, light, conducting, diaphragm is suspended between two fixed, perforated, electrodes. For low distortion, there are two main requirements: the unit must be push-pull, as in Fig. 1, and it must be driven with a constant charge on the diaphragm. Early units were either only single sided, or polarized with a constant voltage, in either case this results in heavy distortion.

Figs. 2 and 3 show a mating pair of fixed plates. They are made from any rigid, flat, insulating material. Acrylic ("Plexiglas", or "Perspex") was used in the prototypes. Likewise, the precise thickness does not matter very much. The description here is based on 3mm

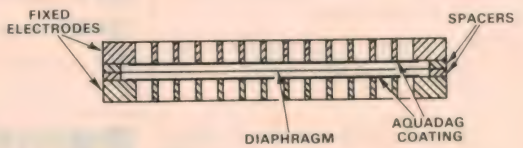


FIG. 1

Fig. 1. The basic elements of the electrostatic loudspeaker, using a push-pull drive system.

*82 Bible St., Eltham, Victoria 3095

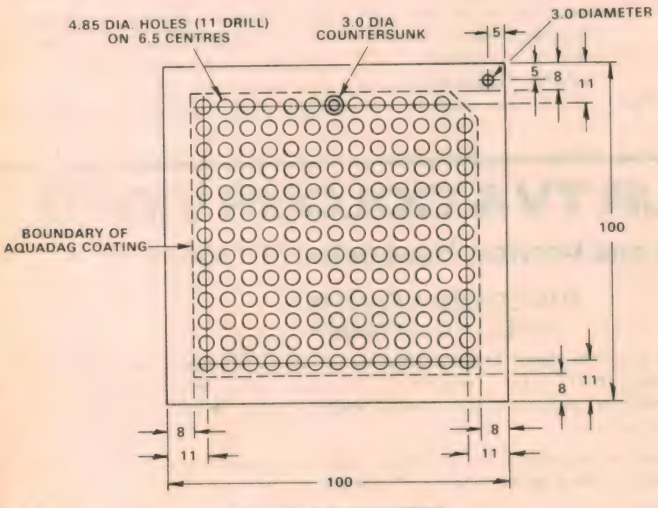


FIG. 2 DIMENSIONS IN MILLIMETRES

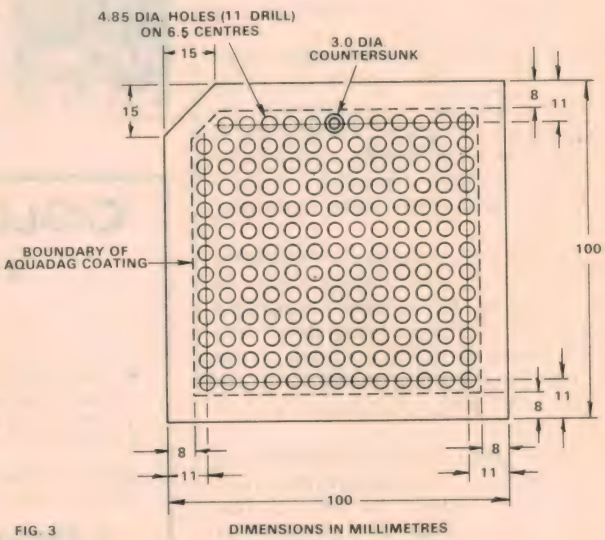


FIG. 3 DIMENSIONS IN MILLIMETRES

Figs. 2 and 3. A mating pair of fixed plates. They are made from "Plexiglas" or "Perspex" about 3mm thick and drilled as shown. The countersunk holes are for the terminals, the surface of the plates being made conductive with a coating of "Aquadag". Thirty two such plates must be drilled (for a stereo system) and the text describes a drilling jig to simplify this task.

sheet, which is a convenient size.

The first job is to saw the sheet into 100mm squares. Then the holes have to be drilled. This is not as tedious as you might think, if you make up a simple drilling jig, like the one in Fig. 4. A stack of 6 or so plates can be drilled at one go. Use a sharp bit, a fairly low speed if possible, and clamp the plates tightly together. When making the drilling jig, use a piece of matrix board as a drilling guide for the holes. Clean any swarf or ragged edges from the holes in the plastic plates after drilling. Note the two countersunk holes.

(The author's system uses eight of these electrostatic speaker cells in each channel. On this basis, at least 32 fixed plates would have to be drilled, fully justifying the use of a jig.)

The next job is to put a conducting layer on to the fixed plates. This is done with a coat of "Aquadag", an aqueous suspension of carbon. Figs. 2 and 3 show the area to be painted. Before applying the Aquadag, roughen the whole plate area with fine wet and dry. Be reasonably generous with the Aquadag, aiming for a smooth, continuous, but not overthick layer. Paint well down into the countersunk holes; this is where the terminals go. From corner to corner, the resistance should be a few hundred ohms. The actual value doesn't matter.

"Aquadag" is available from Acheson ANZ P/L, 2 Shepherd St., Chippendale, NSW, or 475 La Trobe St., Melbourne.)

Fit 3mm (or 6 BA), 15mm (½ in.) long, countersunk screws into the countersunk holes, using shakeproof washers. These are the terminals for the fixed electrodes.

Next, paint a coat of clear, glossy polyurethane plastic over the aquadag. This step could possibly be omitted, but, for long term protection of the carbon coating, is worth including.

The fixed plates have to be spaced about 0.4mm (0.015 in.) from the diaphragm. Spacers, which are shown in Fig. 5, can be of almost any 0.4mm (0.015 in.) insulating material. The prototypes used a process paper called "Elefantide". The easiest way of making a quantity of spacers is with a metal cutting guide, of the same shape as the spacers, but for a moderate number it is probably just as satisfactory to use a straight edge.

The spacers are glued to the appropriate plates, i.e., the spacer with the corner missing obviously goes on the plate without the corner. Clean the surfaces to be glued carefully with methylated spirit. Be reasonably generous with the epoxy cement, and clamp tightly while the glue is setting. Put the plate on a flat surface, cover the top of the plate (with spacer cemented in place) with polythene sheet, then a square of flat material, like chipboard, and finally a heavy weight (an old transformer, or a brick) on top. Provided the same principle is observed, a number of plates and spacers can be stacked up, while the epoxy is setting.

Now comes the most crucial step in the whole exercise. The diaphragm is a thin membrane of polyester foil, of the type that is sold for cooking, e.g., "Look", or "See-n-cook". The thickness of these foils is around 0.0125mm (0.0005 in.), which is about right. The foil has to be tensioned before being attached to one of the fixed plates. The degree of tension determines the fundamental resonance, and hence the low frequency cut-off, because the response falls off rapidly below the resonance, just as in a moving coil speaker.

A simple jig is needed for tensioning the foil. The foil is clamped between two rings and then stretched over a flat disc. The construction of the jig is shown in Fig. 6. It uses chipboard, rubber, and

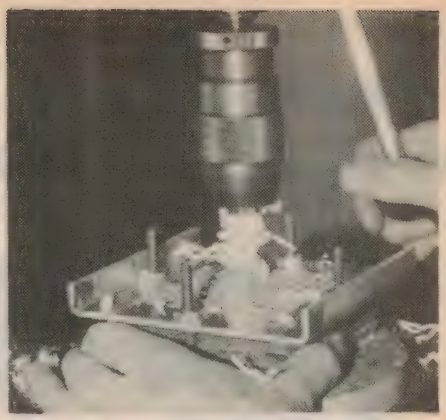
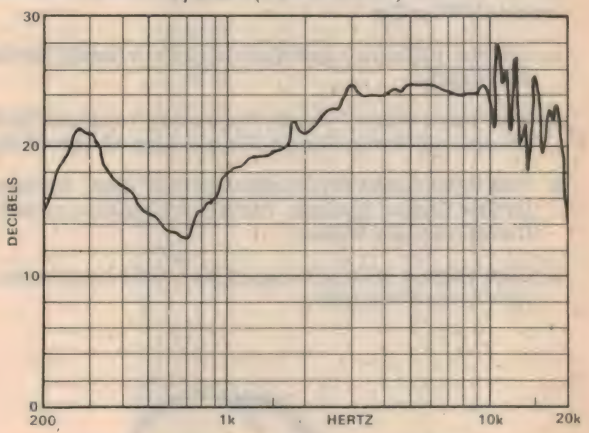


Fig. 4. The tedium of drilling the plates can be reduced by making this simple jig. A complete system (eight units) requires 16 plates (32 for stereo).

A response curve of a typical unit. The original curve was drawn by a Bruel & Kjoer frequency response analyser and was redrawn by our draughtsman to facilitate reproduction.



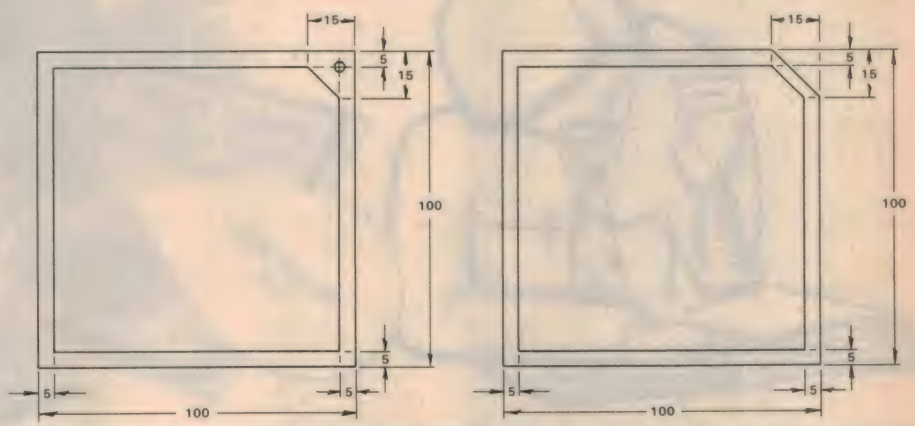


Fig. 5. A spacer is required between each Perspex plate and the diaphragm. These are made from 0.4mm process paper, and cut to the patterns shown above. They are glued to the appropriate plates with epoxy cement.

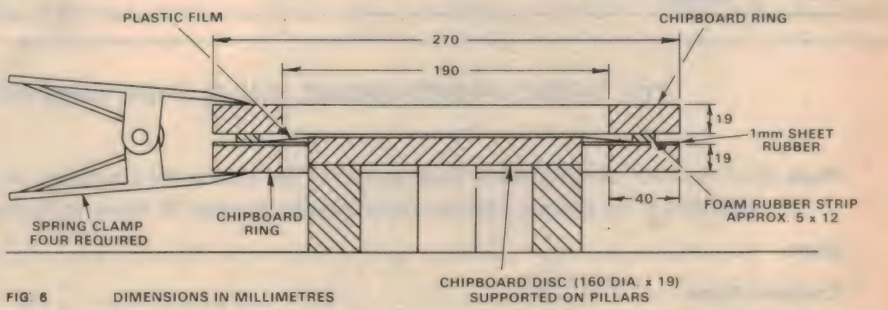


Fig. 6. One of the most important jobs in constructing the speaker units is to tension the diaphragm correctly. This drawing gives details of the jig and the manner in which it is used to ensure consistent results. See also photograph on next page.

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some spring clamps. Two rings are cut from the chipboard and one from the rubber. These make a circular clamp to hold the foil. A disc, with a diameter slightly smaller than the inside of the ring clamp, is also cut from the chipboard.

The tension in the foil is determined by the mass of the ring, and the angle made by the foil at the edge of the disc. For a 500Hz crossover, the resonance should be around 350Hz. A tension in the region of 11 x 10^6 N/m^2 (1600lb/square in.) will achieve this. Without bothering about measuring angles, etc., stretch the foil flat and free from wrinkles across the ring, without any appreciable tension, before putting the clamps on. Make the total mass of the ring, clamps, etc., about 1.7kg (3.7lb), and the tension will come out fairly consistently at the right value.

Having stretched the plastic foil over the disc, take a fixed plate without the missing corner (Fig. 2), with its spacer attached. Put a fairly generous smear of epoxy around the spacer, place on top of the stretched foil on the disc, and put a weight on top while it sets. Clean the spacer and the foil carefully with methylated spirit before gluing. When the epoxy has set (one of the 5 minute varieties saves a lot of waiting), trim the surplus foil from around the edge of the plate.

The diaphragm now needs a high resistance coating. There are three reasons for this:–

(i) To maintain a constant charge on the diaphragm, the time constant of the diaphragm resistance and its capacitance, relative to the fixed plates, must be long compared with the period of the lowest frequency.

(ii) To prevent charge migrating around the diaphragm, while it is vibrating.

(iii) To prevent sparking from the diaphragm to the plates. With a high resistance coating, if there is any tendency for the air to ionise at any particular point, no harm can result as there will be insufficient charge available at any one point to cause a spark.

In practice, preventing sparking is a crucial factor in making a satisfactory electrostatic unit. The first units made had a low resistance evaporated aluminium coating, and to work at constant charge the polarizing voltage was supplied via a high resistance. However, sooner or later, these units would tend to spark over, causing either an audible click, or burning a pin hole in the diaphragm.

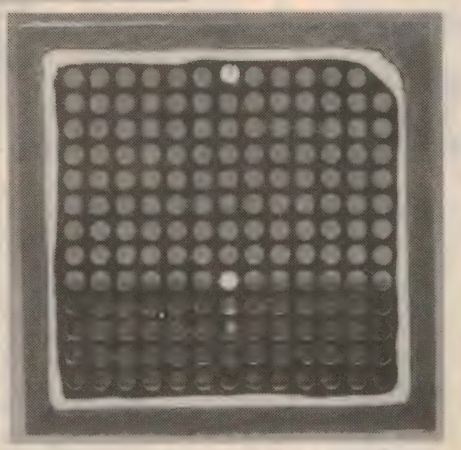
After a lot of research to find a suitable high resistance coating, a drawing ink was found that does the job perfectly. It not only wets beautifully on the plastic, but has a resistivity close to optimum (1000 megohms per square). The type is Pelikan Drawing Ink TT, specially formulated for polyester sheet.

The ink is painted over the diaphragm quite sparingly. (Fig. 7.) When dry, the diaphragm should be a light brown colour when held up to the light. The ink should cover a similar area, on the diaphragm, as the aquadag on the plates. Bring the ink out to the corner where the terminal goes, and, when the ink is dry, attach a 3mm (or 6 BA) bolt to form the terminal, with a plain washer under the bolt head, and a shakeproof washer under the nut.

All that needs to be done now, to finish the job, is to glue the other fixed plate, with spacer attached, to the plate with the diaphragm, using epoxy cement. Don't be mean with the epoxy and clamp the plates firmly together, while the glue is setting, between squares of chipboard suitably drilled to accommodate the terminals. Finally, trim the edges with a sharp knife, to remove surplus glue, etc. You now have a completed electrostatic loudspeaker element.

With the diaphragm under tension a fixed plate, with spacer attached, is cemented to it and left under pressure (the transformer) until the cement sets.

After the diaphragm has been glued to one plate it is made conductive with a coating of drawing ink, as shown. Note the corner pattern, to mate with the terminal.



A drilled plate, coated with Aquadag, fitted with a terminal, and with a spacer glued in position.

The only really significant trouble encountered in making the prototype units was, at first, a marked variation in sensitivity between units. This turned out to be caused by assembling the units during a particularly cold spell. If the temperature is too low, the epoxy cement remains stiff and viscous and adds significantly to the thickness of the spacers, which separate the two plates from the diaphragm, thus reducing the sensitivity.

The obvious answer is to do the gluing at a temperature of at least 20°C, and also use a free flowing epoxy, such as Fast Set Araldite. Another point to watch is that the plates themselves must be flat: any that are bowed by more than 0.05mm (0.002 in.) should be rejected.

FURTHER READING ON ELECTROSTATIC SPEAKERS

1. "Electroacoustics", by F. V. Hunt, Harvard University Press, and J. Wiley and Sons, 1954, pp. 167-212, 202, 205.
2. "Wide Range Electrostatic Loudspeakers", P. J. Walker, Wireless World, May, June, August, 1955.
3. "Horn-Load Electrostatic Loudspeaker", Josef Merhaut, Journal of the Audio Engineering Society, November, 1971.
4. "Full-Range Electrostatic Loudspeakers", H. J. Leak and A. B. Sarkar, Wireless World, October, 1956.
5. "An Electrostatic Loudspeaker Development", Arthur A. Janszen, Journal of the Audio Engineering Society, April, 1955.

Line output "jungle" ICs for colour and b&w TV sets

Offering as they do significant advantages in terms of initial cost, inventory control, and servicing, integrated circuits are finding increasing application in both colour and monochrome television receivers. Indeed, a range of ICs covering virtually all of the signal processing circuits of a PAL colour TV receiver is now available. This article describes two recently released ICs for use in line output stages.

by J. BRIAN DANCE, M.Sc.

Two "TV jungle" integrated circuits for use in the line output stages of monochrome and colour television receivers have been released overseas recently by ITT Semiconductors.

The first device, the TBA940, is designed for use in colour TV receivers. It generates 7us pulses suitable for driving a thyristor output stage. The second device, the TBA950, is designed for use in monochrome receivers, and generates 27us pulses for driving a line output transistor.

Both the TBA940 and the TBA950 devices contain a sync separator circuit with noise suppression, a frame integration network, a phase comparator, a switching stage for the automatic changeover of noise immunity, a line oscillator with a frequency range limiter, a phase control circuit, an output stage and a supply voltage stabiliser. It is easy to understand why such devices are referred to as 'jungle' circuits. Their use greatly reduces the number of other components required.

Typical circuits employing the TBA940 and the TBA950 are shown in Figs. 1 and 2 respectively. The following description of the various circuit functions holds true for both devices, unless otherwise indicated.

The video input signal is fed via a resistor and capacitor to pin 5 and thence to the amplitude limiter, sync separator, etc. The integrated and processed pulses for triggering the frame oscillator appear at pin 7.

The control voltage for fine tuning the line oscillator is produced in the internal phase comparator circuit. The 0.47uF capacitor in the pin 4 circuit is charged at a rate proportional to the phase deviation between the synchronising pulse and the oscillator sawtooth voltage.

During pull-in, only the 0.47uF capacitor is effective in controlling the time constant, so synchronisation is rapidly effected. Afterwards the time constant is controlled by the 10uF capacitor connected to pin 9. The resultant large time constant reduces the pull-in range to about 50Hz and this results in good noise and interference rejection.

The line oscillator produces a sawtooth voltage by charging and discharging the capacitor in the pin 13 circuit from a constant current source. The amplitude of this current is determined by the resistance in the pin 14 circuit. The frequency can be set over a range of plus and minus 5% by the potentiometer in this circuit.

The oscillator frequency is given by:

$$f(kHz) = 1640/R(kohm)C(nF)$$

where C and R are the capacitor and resistor values in the pin 13 and pin 14 circuits respectively.

The line output stage is protected by a circuit which prevents the oscillator frequency from deviating by more than plus or minus 6% from the nominal value to which it has been set. A further protective circuit prevents pulses of indefinite length and frequency from being fed to the output stage when the supply voltage is low (e.g., when the receiver is switched on or off).

Both the TBA940 and TBA950 incorporate a phase control circuit which compares the phase of the line flyback pulses with that of the oscillator sawtooth voltage. The phase position is set by means of a threshold switch which determines the beginning and end of the output pulse by comparing it with the sawtooth waveform.

The capacitor in the pin 12 circuit filters the control voltage which is applied to the threshold switch so that switching of the threshold changes according to the phase set at pin 11. This makes the phase position of the line flyback pulse independent of the delay times in the line output stage.

The pin 3 voltage is internally stabilised at about 9.2V. The series resistor Rv in

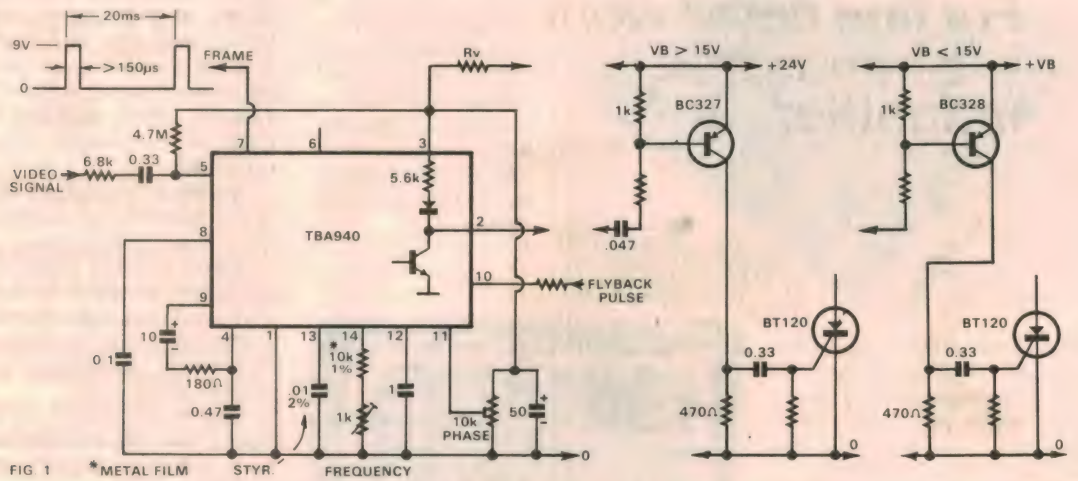


FIG 1

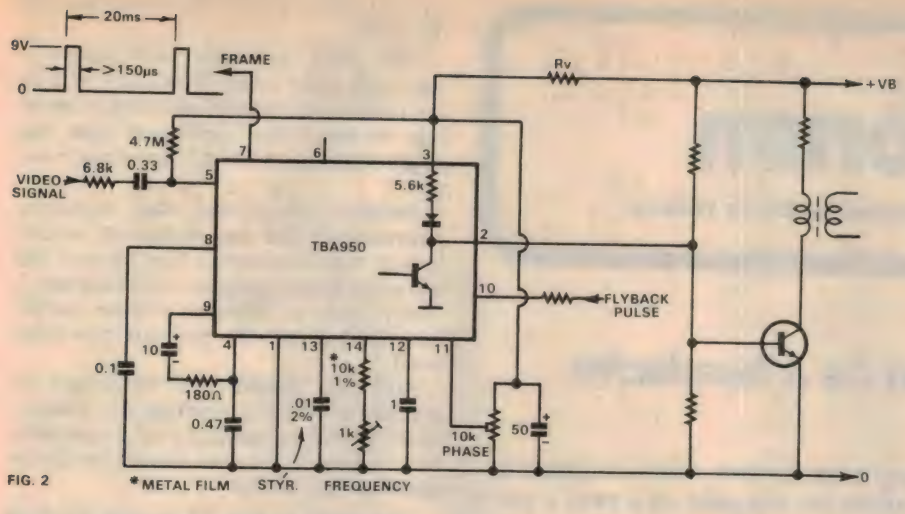


FIG. 2

Figs. 1 and 2 must have a value which will ensure that the maximum permissible power dissipation in the integrated circuit is not exceeded. It may be 390 ohm for a 24V supply or 220 ohm for a 20V supply.

By itself, the TBA940 cannot produce the peak current of around 0.4A which is required to drive the BT120 thyristor into conduction with certainty. The output pulse from pin 2 is therefore used to control a pnp driver transistor.

When supply voltages above about 15 to 20V are employed, the output pulse from pin 2 must be capacitively coupled to this transistor to ensure that the permissible blocking voltage is not exceeded within the TBA940. The RC network in the BT120 gate circuit produces a negative voltage during pulse intervals, which keeps the gate blocked.

A driver transistor is employed in the Fig. 2 circuit between the output of the TBA950 and the line output transistor, since an appreciable amount of driving power is required.

Summing up, the use of integrated circuits in the sync and sweep stages can greatly simplify circuitry. A special feature of the devices discussed is the internal integration of the frame pulses. This ensures that the frame pulse is free of line pulses and removes interfacing problems.

Forum

Conducted by Neville Williams

Community aerials can be a headache

There's an old saying which, if brought up to date, could suggest that "it's all too easy to spoil a luxury cruiser for the sake of a cent's worth of caulking compound". In another context, one might observe that it's also easy to ruin enjoyable colour TV viewing for the sake of a decent aerial.

If you think that I'm getting set for a tirade against TV aerial companies, you are wrong.

True, there has been evidence that some TV aerial, rental and installation companies have been over-keen to tear down the old aerials and replace them with new ones; in some cases, this has added up to a rip-off. But at least, when the job was done, the viewer did have a shiny new aerial and lead-in and hopefully, did have optimum viewing for the particular locality.

What I am concerned with here is the other side of the coin, where residents who could be enjoying some good colour viewing are not getting it because they WON'T—or someone didn't—consult or employ a specialist aerial company to solve their problems.

The scenario is not by any means an unfamiliar one but it came forcefully to my notice when a member of our staff, the proud owner of a new 22-inch colour set, moved into another block of home units. Whereas previously he had been able to enjoy good reception of all stations, he now found himself with an atrocious signal from channel 2, an indifferent signal from 7, a passable signal from 9 (but subject to interference) and a fairly good signal from 10.

This in a near to optimum viewing area!

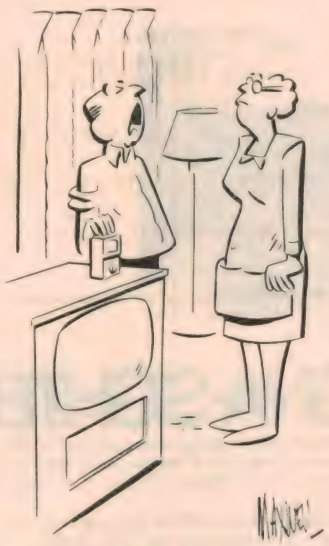
Having a technical background, he was able to do a little quiet detective work and found that the six units involved shared a common aerial on the roof, with the signal simply fed in sequence to sockets in the respective living rooms, using 300-ohm cable. There was no amplifier in the system but, more importantly, there were no splitter resistors anywhere in the line.

And this typifies an all-too-common silly situation. An investor contracts for a block of home units. They have to conform to the local building codes; they have to keep out the wind and rain and take due account of the sunlight; they need to be carpeted and curtained and may have attractive light fittings and the approved number of power points; they have to present a certain air of comfort, even of opulence, to attract takers.

The grounds have to be suitably ordered, or even landscaped.

Ah yes . . . television reception? A central aerial system must be provided, with neat little outlets in every unit!

But, good heavens! You can't afford to have it done by one of those specialist TV aerial installers. They charge the earth! Joe Blow down the street will run the wires for half the price, or the electrician can put them in while he's running the power and light wiring. An apprentice, or an odd job man can fix the sockets to the walls.



"That's precisely why the Government in its wisdom planned four stations in each city . . . so that unit dwellers could get a good signal from at least one of them!"
(With acknowledgement to "PF Reporter")

And that's precisely what happens, over and over again. Television signals are reticulated around residential buildings in much the same way that one might reticulate 240V AC, or an alarm circuit.

Another one of our staff members, overhearing the conversation, volunteered the information that his unit did not even boast a proper outlet socket. A 9-inch stub of 300-ohm ribbon simply emerged from the poured concrete wall!

And why shouldn't it? There are no regulations at all governing the characteristics and performance of community aerial systems. You can simply get some bloke to put 'em in!

The point is that TV signals are high frequency radio energy and they cannot—or should not—be reticulated in this way. Discrete lengths of ribbon or coaxial cable exhibit a particular impedance, depending on the characteristics of the cable, its length, the frequency of the signal concerned and what is connected to its far end. For example, a length of cable with nothing connected to its far end may appear as a short circuit if it happens to be an odd number of electrical quarter-waves at a particular frequency; add one quarter-wave, so that it becomes an even number, and it looks like an open circuit!

Make it some in-between length, and you get an in-between impedance.

When TV aerial wiring is run randomly from point to point in a residential building, the result is likewise hopelessly random. For example, resident E plugs his set into his own aerial point and electrically, he makes a connection to the aerial on the roof. But unfortunately, on its way, the lead connects to points for residents A, B and C and the line therefore may or may not be loaded at these points with additional sets. Maybe there's a branch that runs off to D's unit, while the line continues on, with further branches, to units for F, G and H.

All these tappings and branches cause mismatches within the system, which produce standing-wave effects, weak signals, reflections and ghosts. They vary from station to station, and from unit to unit, and they may also vary according to whether occupants have sets plugged in or tuned to different channels.

And because all the sets are connected directly together via the aerial cable, there is a heightened possibility that oscillator radiation from some sets will affect others, depending on who happens to be watching what channel at a particular time.

An experienced TV installation company will never wire a TV aerial system in this fashion.

To begin with, they will probably use coaxial cable rather than 300-ohm ribbon to make it less sensitive to the building environment, whether run through or

against metal, or buried in concrete, etc. But, whether ribbon or coaxial cable, they will also instal isolating pads (or resistors) at each junction in an effort to maintain an overall impedance match and to isolate receivers from one another.

For a large installation, involving a lot of receivers and a lot of pads—therefore a lot of line loss—they will use a very high gain aerial, or multiple aerials, or even a master amplifier to boost the signals before they are fed into the lines.

To be sure it costs money, but it can guarantee satisfaction from the word go and it can also save an expensive re-installation. How expensive is illustrated by a story recounted to us of a prestigious motel on the South Coast of NSW. Before it could offer its clients worthwhile colour in every suite, the original "bargain" aerial system had to be abandoned and a completely new system grouted and routed through the all-concrete structure.

Think back over your own travels. How often have you found a good signal to back up the sign outside: "TV in every suite"? More often than not, after one has "unwiggled" the controls and reset them all for best results, the picture still bears eloquent testimony to a poor aerial system.

Our staff member, mentioned earlier in the article, found that he was able to get some cooperation with other residents and, by the judicious introduction of resistors into the line behind the points, was able to effect a considerable improvement. But he was lucky: it was a small installation, the people involved were cooperative and the line was sufficiently accessible to permit modification.

But it isn't always that way.

Consider another case which I came across personally in the last few days:

It concerns a very large, very prestigious, multi-tower group of home units on Sydney's north shore. Over fifty home units are involved, presided over by a body corporate, or some such thing, which holds its meetings at regular and appropriate intervals. It's all very dignified and businesslike.

But some of the residents have one serious and common lament: although there is a clear line of sight from the roof to the nearby television towers, they can't get a decent signal from the community TV aerial system. In desperation, they try to get by with rabbit-ears on small portables.

As one of the residents—a personal friend put it to me—what's the use of buying a colour set in those circumstances?

I'm afraid my retort was as spontaneous as it was naive:

"No problem: you get the governing body to call in a specialist TV aerial company to diagnose the problem. Even if the aerial system needs a fairly expensive up-dating, it surely would not be beyond the means of the residents of such a complex!"

References and texts for your library:

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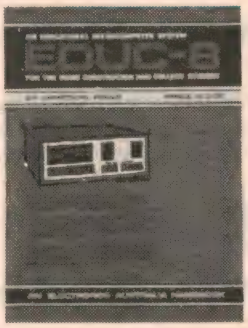

The latest addition to our handbook series brings the published articles on our EDUC-8 do-it-yourself computer system together inside a single cover. It also provides additional information, including how to expand the memory, arithmetic and input-output facilities. If you haven't started building the system, it would make an ideal guide; if you are well advanced, you'll find it makes an attractive and convenient operating manual. Even if you don't intend building up a computer, it provides an easy-to-read text on the "nitty gritty" of computer operation and programming.

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FORUM

But that had been tried already . . . or at least the proposition had been put.

Unfortunately, one or two residents with rather loud voices and a persuasive manner had postulated that TV installation companies were far more notable for charges than for results. In fact, one of the residents had a friend—an "expert"—who had been his guest recently and who offered the opinion that, if the residents on average were getting three reasonable signals out of four, they were doing as well as they could expect.

What a load of garbage. For viewers on the fringe or down behind one of Sydney's rocky bluffs, three out of four signals might be a bonus but certainly not in a direct line of sight to the towers.

And yet that's the situation: a group of owners in an enormously valuable set of units, mumbling and grumbling about lack of TV reception because, a few years back, the investors put in a cut-price antenna system. And because, even now, the vocal resident minority prefers to mumble and grumble and to take homespun advice, than to get the matter rectified.

An unfortunate aspect of such an "after the event" situation is that poor TV reception is likely to be less of a problem for those who happen to be on the transmitter side of the building, than for those on the other side. And, of course, it is no problem at all for those who rarely watch TV. Which means that the disadvantaged are trapped; they can't take individual action and they can't take group action unless they can get majority assent, and probably pay for the whole job themselves!

One hesitates to suggest adding another regulation to the maze which already surrounds us but there would seem to be a case for an all-or-nothing stipulation in the building code: either a properly installed and certified community TV aerial system or none at all. At least you would know what you are getting—or not getting!

After all, when one checks for lights, power points, telephone, etc, one expects them to work. Surely that's the way it should be with TV signal outlets.

There's another point: the ABCB has been talking recently about the possibility of UHF repeater stations to serve areas shadowed from the present VHF transmissions. More than ever, these will call for a decent distribution system in multi-apartment buildings. Fancy trying to reticulate UHF by cut-price 50Hz techniques!

★ ★ ★

To change the subject and, at the same time, to turn back the clock, here's a letter that may cause some of our older readers to flip back through the pages of their memory:

Dear Sir,

I have recently become the proud owner of the little loudspeaker shown in the accompanying photograph. It would be about the cutest thing I have seen in a long time and it is hard to credit that it was once the latest product and someone's pride and joy. It has created a lot of interest here and we would all like to establish how old it is.

I would be delighted if you could put an approximate age on it and possibly the country of origin. There are a few details on the back of the photo which might give a lead.

I would like to add that I have been one of your regular readers for many years and have always regarded your publication as my own particular "fountain of knowledge". Turning to you for information seemed to be the natural thing to do.

F.R. (Gisborne, NZ)

How old is this horn loudspeaker? A name transfer on the base identifies it as the "TRUE MUSIC JUNIOR". Pat. App. No. 4103/23. Height is 17½in and flare diameter 6in.

We didn't recognise the loudspeaker by name, although its general style was familiar to a couple of our staff members. In fact, one of the oddments around my own workshop for many years was a funnel which someone had cut from a flare almost identical with the one pictured. Such is our respect for wireless gear when it is too old to be of immediate use but too young to be an antique!

My tip is that the "23" in the patent note signifies 1923, and that the actual unit was produced shortly after that. A cursory look through old publications seemed to suggest that horn loudspeakers before 1923 were simpler, with straight-sided flares, while those in the late twenties were generally more ornate. We'll settle for 1925!

In fact, F.R. may have started something with his letter. Once the veterans start raking back through their memories, their papers and their dusty cupboards, who knows what may turn up?

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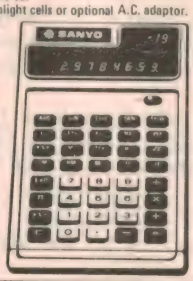

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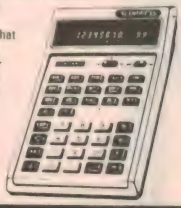

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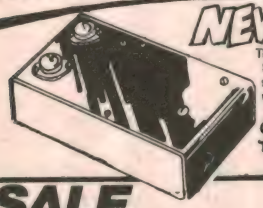

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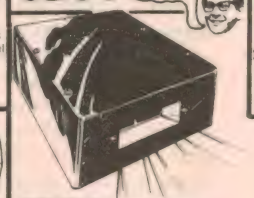

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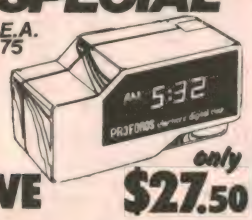

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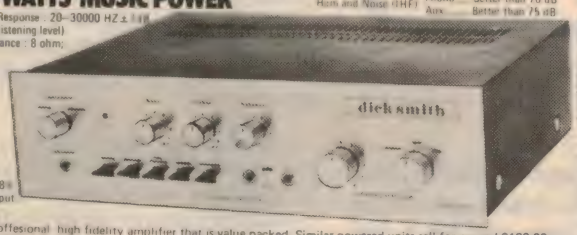

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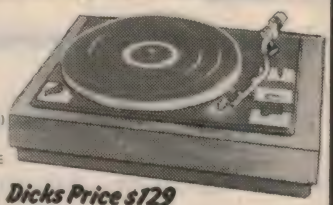

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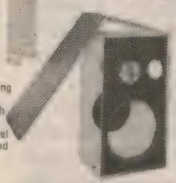


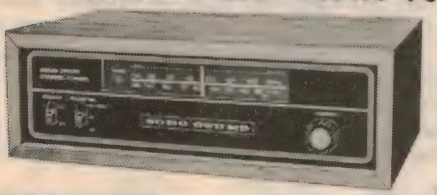
The model SC-2K comes complete with everything you need, even glue!
The system incorporates an 8 inch woofer, 2 inch mid-range and 2 inch tweeter. To make your speaker system even more professional a high level frequency control enables you to adjust the sound setting to suit your own ear.
The cabinet finish is wood and the grill front a beaut orange acoustic cloth.

SPECIFICATIONS
Power Handling .....25 Watts RMS
Frequency Response.....40 - 20,000Hz
Impedance 8ohms
Crossover Frequency..3kHz-10kHz
Dimensions..456mm(H)x253mm(W) x205mm(D)
Net Weight.....5.4kg

Dicks Price $69ea

Try these optional units with the above system or with your own present HI-FI equipment

AM/FM STEREO~MONO TUNER



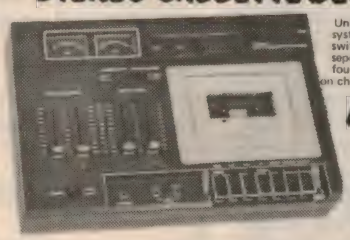
was $75
now **$65**

The ECHOSOUND TUNER is incredible value for money with separate AM and FM front ends, 10 transistors and 14 diodes. Covers FM 88 to 108MHz AFC, 60db S/N, 35 db separation, 600mV output AM 535 to 1605kHz ferrit rod antenna. Features multiplex adaptor complete with built in stereo indicator. 240V AC operation. Complete in walnut case.

P&P FREE

Guaranteed for 12 months.

STEREO CASSETTE DECK EXPO SX~101

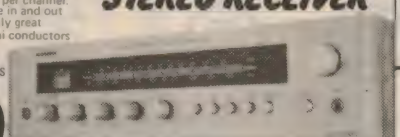


Unit has twin Vu meters Piano key control system with auto shutoff and review cue. Chrome switch and noise filter built in playback level and seperate record levels. Plus many features only found on more expensive units. Frequency response on chrome 40-15kHz and measures 370 x 255 x 90 mm

looks $200 worth
Dicks Price
$159.00

RECEIVE YOUR FAVOURITE FM BROADCAST on a SONICS MR7000 STEREO RECEIVER

Ideal complement to your system this receiver hasAM/FM Stereo/Mono plus a healthy 17 watts RMS per channel. Has all features of a top unit including tape in and out mic input · push button controls and a truly great design. For AC use. It has a total of 37 semi conductors and two ceramic filters.



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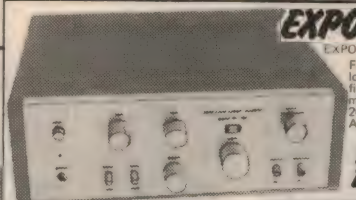
our price $179

EXPO 1212 STEREO AMP

EXPO DX 1212 12 + 12 WRMS STEREO AMPLIFIER



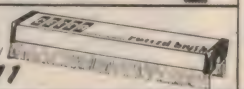
Full control amplifier · smart design with switches for loudness · tape monitoring · stereo/mono and high filter. Will take your Goldring ES 70S through its magnetic phono input. Frequency response from 20hz to 25khz · S/N ratio better than 60dB on phono Also accepts stereo Headphones 8-16 ohms.

SAVE $20 at DICKS price of **$99**

GOLDRING ES70S SPECIAL PRICE $4.75

SPECIAL SPECIAL

Decca Brush—clean your records the professional way. No liquids needed-everything is done by the 1 million yes 1 million conductive bristles, a truly remarkable way to rid your records of dust.
Dicks price only $11.00. Save 95c. on R/R.



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NATIONAL RS-460S Stereo Portable Cassette with AM radio and FM Stereo radio. AC/DC or car/boat use via adaptor · built in microphones (2 per stereo) · 2 x 1 watt RMSoutput · has auto stop function · 2 x 3½" dynamic speakers and of course FM stereo radio (a must for audiophiles) and AM radio. Record direct from radio onto tape or connect the RS4505 into your home audio for even more dynamic use.
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The Serviceman

The importance of service data

One of the important "aids to servicing" for every serviceman is the manufacturer's service manual, and any modification sheets which he may subsequently issue. Keeping track of all these data can be a big job, but failure to do so can have serious consequences.

My first story this month emphasises the importance of service manuals and similar data. It concerns an AWA TV set, series 50-00 model, suffering from no picture, the immediate cause of which was complete lack of EHT. This, in turn, was found to be due to an EHT transformer with shorted turns.

There were two unusual aspects about this fault. One was that my records showed that the same set had been serviced some 20 months previously for exactly the same fault; failure of the EHT transformer. The other was that failure of an EHT transformer in this brand of set is extremely rare, while failure of two in the same set is virtually unknown.

By implication, then, the transformer failure was a symptom rather than a basic fault. Maybe I'd been caught the first time, but I was determined not to be tricked again.

My record sheet also reminded me that, when the first transformer was replaced, the EHT had seemed, if not excessive, at least right up to its rated value. So much so that I found it necessary to add some extra insulation to the EHT lead from the transformer to the 1B3 rectifier cap, to control a tendency to flash over.

Since I had to call into the firm's service department to obtain a new EHT transformer, I took the opportunity to raise the matter and enquire whether there was any record of similar failures. As a result I was handed a modification sheet—which, for some inexplicable reason I had not seen before—entitled, "50 Series Circuit Improvement", the relevant portion of which reads as follows:

"Under some conditions, including incorrect width and horizontal linearity settings, it is possible for high EHT to be developed in the 50 series TV chassis. When high EHT is generated, greater than 18kV (zero beam) premature failure of EHT rectifier valves may result. This failure will normally burn up R427 1k ohm ½w resistor, which is in series with the EHT lead. In some cases in the field, because of wax being noted as having dropped from the EHT transformer, the transformer, as well as the EHT rectifier and the 1k resistor, has been replaced. Our observations have shown that wax dripping from the EHT transformer, is not often an indication of transformer failure. Our tests on transformers replaced as defective for this reason indicate that the majority are in no way defective.

"In current production of 50 series chassis, this problem has been overcome by addition of a 68pf 4kV capacitor from cathode of 6AU4—GTA valve (pin 3) to junction of C426 and C427 and by increasing R415 from 1meg to 2.2meg (grid resistor on 6CM5).

"It is recommended that above alterations be carried out whenever earlier 50 series chassis are serviced in the field, in which the EHT at zero beam current is greater than 18kV.

"It is important that the horizontal linearity and width controls be correctly adjusted after carrying out these alterations. The correct adjustment of the horizontal linearity will be not more than 2 turns from minimum current through the line output valve. This current can be checked by measuring the voltage across a 1.5 ohm resistor inserted in the 6CM5 cathode circuit, or could be checked by inserting a 12 volt dial light in the 6CM5 plate circuit and adjusting for minimum globe brightness. The width control should be adjusted for 610 volts ± 20 volts which should correspond to about ¾in overscan either side on 23in or 25in picture tube."

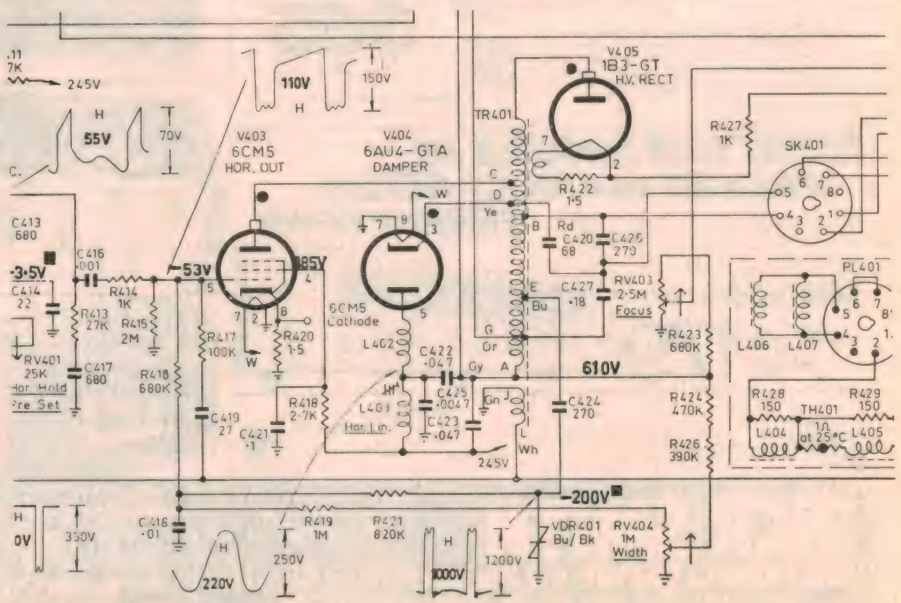
(The voltage referred to in regard to the width adjustment—610V—is the boost voltage, the setting up procedure being covered in greater detail in the original service data.)

Back at the shop I set about fitting the new transformer and making the recommended modifications, hopeful that the latter would solve the basic problem. Unfortunately, that was being too optimistic. When I switched the set on there was still every indication of more EHT than there should have been.

Remembering the reference in both the original data sheets and the modification sheet to the critical nature of the boost voltage setting, I checked this first. This turned out to be closer to 800V than the specified 610. What was more, the width control had no effect on either the boost voltage or the actual picture width.

A step by step component check soon revealed the culprit; the 680k resistor in the grid circuit of the 6CM5 output valve was open, depriving the width pot of voltage. Strangely, it appears that this condition, or something approaching it, must have existed when I replaced the first transformer, yet it had no adverse effect on the picture geometry.

Naturally, it was a simple matter to fix this fault. This brought the boost voltage



The relevant portion of the circuit discussed in this article. This is an updated version in which the modifications have been made. Failure of R416, 680k, was the main cause of excessive boost and EHT voltage, and subsequent transformer failure.

down to a much more reasonable figure, which then responded to the width control, as per the manufacturer's instructions. And, of course, I could now vary the picture width.

Which I thought was the end of the story. But, as is my habit, I let the set run on the bench until I was ready to return it to the owner. And just as well I did. Some time later I looked at the picture and found it suffering from the most dreadful horizontal jitter.

Fortunately, a glance into the works was sufficient to reveal the culprit; the 1k resistor in the EHT lead. It was turning on a miniature fireworks display in the form of multitudes of little arcs along its surface. A new one solved that problem.

At the inevitable self-inflicted post mortem I tried to work out how I had overlooked the basic fault the first time. It's always easy to be wise after the event, but trying to look at the job as I saw it at the time, it appeared to be nothing more than an EHT transformer which had given up the ghost. I had a replacement on the truck and I fitted it on the spot. The set came to life normally and the only hint I had of anything unusual was the rather lively EHT voltage.

Had I already been aware of the modification note issued by the makers I might have been alerted by this symptom. Just why I hadn't seen that particular one will probably remain a mystery and there seems to be little point in trying to blame anyone at this stage.

But it does highlight the importance of such notes, and the need to see that they are all received, digested, and filed. The other point to emphasise is the need to be on the alert for a fault which repeats itself, particularly one which is unusual in itself.

My next story has quite a different background. At a social function I found myself chatting to a serviceman from a somewhat different sphere of electronics. Stationed at one of our east coast ports, his job is to service and maintain the radio equipment on the ships entering the port. This is mostly confined to local shipping, but sometimes involves overseas ships in an emergency.

It is an interesting job, involving equipment ranging all the way from old fashioned and relatively simple valve type telegraphic equipment to the latest frequency synthesisers which give any frequency in the system at the touch of a button, plus whatever mode is required—SSB, AM, FM, etc—equally simply.

All this is by way of background. His other interest, and the one that prompted this story, is amateur radio. As might be imagined, his job keeps him up to date on all the latest circuits and components in the commercial world, and he puts this to good use in his hobby. He already has an impressive list of home-brew equipment to his credit.

Even so, there was one piece of ready-made amateur gear which he coveted. This was a very compact hand-held two metre transceiver; an imported unit with a very high reputation and which had already penetrated deeply into the Australian market.

His final decision to buy one was made when a Sydney dealer offered them as a special at a very keen price. Unfortunately, it was several days before he could get to Sydney and, by that time, stocks were exhausted.

Keenly disappointed when told this, he drew the dealer's attention to one remaining unit on show. "Couldn't I have that one?" he enquired.

"I wouldn't like to sell you that one," replied the dealer, "it has quite a story attached to it."

And he proceeded to relate a sad story. The first person who bought it returned it in a couple of days, threw it on the counter, and announced that it was completely useless. While the receiver worked and the transmitter seemed to work, as judged by a field strength meter, he simply could not make any contacts with it.

While puzzled, the dealer didn't argue; he gave him another unit. Then he gave the faulty unit to his technician and told him to check it out. The technician duly did this, removing the detachable telescopic aerial and connecting a dummy load in its place, then measuring RF output, deviation etc.

Strangely, he could find nothing wrong, the transmitter meeting its specifications in all respects. The dealer checked the setup, convinced himself there was nothing wrong with the unit, and put it back in stock. He wrote the customer's story off as due to incompetence, imagination, or even a practical joke on the part of his colleagues, whereby they "ganged up" and agreed "not to hear" his new equipment.

The only snag was that the second person to buy the set brought it back with exactly the same complaint. Placating him with a replacement unit, the dealer had the suspect unit checked again—with the same results. Thoroughly confused, he relegated the set to the role of display dummy while he decided whether to send it back to the makers.

And it was at this point that my friend wanted to buy it.

"Listen", he said, "there can't be that much wrong with it. I'm very keen to get one of these, and I've come a long way. Couldn't we make some kind of deal?"

"Well I'd be happy enough to see the back of it", said the dealer. "If you are prepared to take it with all faults, and no warranty, you can have it at the special price and I'll chuck in a set of nickel cadmium batteries and a charger."

It was too good an offer to miss. My friend knew that he had access to equipment at least as good as that which the dealer had—perhaps better—and was convinced that he could find a logical explanation for the set's strange behaviour. And so the deal was made.

Back home he did exactly what the dealer had done; connected the set to a dummy load and checked RF output and deviation. If anything, the RF output was better than specs; a result, my friend assumed, of its two periods on the test bench when every adjustment had been tuned up to the limit.

Disconnecting the dummy load he refitted the aerial and tried the set on the air. But try as he might, he was unable to make any contacts. Disconnecting the set's own aerial, he tried connecting it to the two-metre whip on his car. Suddenly, everything came good; other amateurs replied and gave him good reports. But when he refitted the original aerial the set was as useless as before.

At this point he naturally suspected a faulty aerial, but a most careful check on this revealed nothing wrong. In fact, a field strength meter indicated a healthy RF output.

The mystery was solved, at least in part, when he substituted an ordinary receiver for the field strength meter. There was no doubt that plenty of RF was being radiated, but there was no deviation. Yet, connected to a dummy load the measured deviation was correct. Similarly, when connected to a separate aerial, it seemed to perform normally.

To cut a long story short, my friend soon twigged what was happening. For some reason the modulator was sensitive to the RF field created by the set's own aerial, and was being so swamped by it that it could not function. With the dummy load fitted there was little radiation to worry it, while the car aerial was apparently far enough away not to bother it.

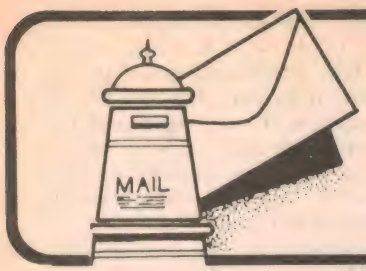
This problem is nothing new. Any transmitter designed to operate in close proximity to its own aerial has to have its modulator, and particularly its first stage, protected against RF breakthrough. On this basis my friend assumed that an RF bypass in the audio input circuit had probably failed, and that a new one would set things right.

But a check on all the appropriate bypasses failed to reveal anything wrong. The basic cause of the problem was as much a mystery as ever. In fact, my friend never did find it. In desperation, he was forced to attack the problem on the basis that, as there was nothing obviously faulty, he would have to fit additional components to protect the modulator from the RF.

His final solution consisted of several modifications; ferrite beads on the input circuits, a metal shield around the first stages, some extra earthing, and so on. None was a complete cure in itself but, collectively, they did the job. So my friend was happy, if still rather puzzled.

I had to agree that it was strange. The set uses a tried and proven design. Hundreds have been sold in Australia alone; thousands have been sold over-

(Continued on page 125)



Letters to the editor

Novice licence

It would appear there is widespread ignorance in this country about the status of the Novice and surprisingly enough by those who should be better informed.

How anyone, particularly fully fledged amateurs, can think that such a simple examination should carry permanency is beyond reason. Let me clarify the position of the novice in other countries. A Novice in America, the home of Ham Radio, has only a two year tenure, and every other country granting Novice or equivalent licencing imposes the same limitation.

To encourage a greater number of people to engage in amateur radio, the PMG has established the novice class of licence with greatly reduced requirements and only a few amateur privileges. It has a term of two years compared with the permanent term of the AOLCP and the AOCP. The objective is to give the newcomer some on the air experience so that he may develop his skills toward a permanent licence more rapidly than he would by textbook study and audio oscillator practice. Requirements for the novice licence are the passing of a code text in sending and receiving at the rate of five words per minute, and a written examination in the most elementary aspects of amateur regulations and theory.

But the most important point concerning the Novice licence in any country, is that it is valid for only two years and may not be renewed. Before the end of his licence term the novice must qualify for a higher grade, the AOLCP or AOCP licence, or go off the air. The Novice class licence therefore offers an ideal way of making a start in Amateur radio.

With its reduced code speed and simplified written examination it grants a portion of the amateur privileges on an apprenticeship basis. The excuse of not having enough time to study for the AOLCP exam, or not being able to assimilate electronics etc. does not gel with me. There are many examples of students, shift workers and others with limited spare time who have qualified for the AOLCP or the AOCP. These examinations are not so difficult anyway. The one suggestion I would make however, is that the pass mark of 70% be dropped to 60%.

Further the Novice licence has nothing in common with the citizens band radio, but so many people seem to think they are almost synonymous.

H. Wright, VK2BZ
Warrimoo, NSW

COMMENT: It is surely rather presumptuous to suggest that those who happen to disagree with your views are doing so because they are ignorant. There is also very little validity in the claim that a regulation is "logical" and right just because similar regulations apply in other countries. Why shouldn't people be allowed to enjoy themselves at a relatively "low" level in amateur radio, and indefinitely if they so wish? So far none of those people who are so keen to push and badger the poor Novices into getting a "higher" licence have offered any really sensible arguments for doing so, and one begins to suspect that the real reason is malice. We couldn't let the poor devils enjoy themselves now, could we?

Definition of time

In reply to Chris Jones' request for a lateral definition of time in the September 1975 issue, here is one more for him to consider: energy-motion is time. Since he did not ask for an explanation as well as a definition, I will leave it at that.

M. Dobbin
Manly, NSW

Hoax letter

Your December 1975 issue of EA contains a letter to the editor in that same section bearing comments and views proposed in my name (and call-sign) regarding 27MHz amateur and pirate activity. It is unfortunate and regretful that such an incident has occurred since I have not sent any such letter to your magazine. I cannot place my finger on who is responsible for that action and hence dare not mention any names or such.

Could you be kind enough to let it be known to your readers that the letter appearing in December 1975 "Letters to the Editor" was not written nor authorised by myself and hence does not officially represent my views, regardless of the content of the letter.

Should you require any evidence of my authenticity, I shall be more than glad to provide it.

I don't hold EA or any of your editors and staff responsible for the above incident.

P. Vernon VK2PV
Dover Heights, NSW

COMMENT: All we can say is that the letter we published appeared to be quite genuine and submitted in good faith. I am sending you a photocopy of the letter in case you can trace the sender using the forged signature, etc., as clues. We regret any embarrassment caused by the incident.

CD-4 discs

I write to bring to your attention a heresy which appeared in "Information Centre", November 1975, in response to a reader's query on Quadradiscs and

stereo compatibility. The pernicious reply finished by advising that "unless you are particularly interested in the music available on CD-4 discs and intend changing to full CD-4 operation in the near future, there seems little point in buying them". Forgive my gasp! I know of no reason for buying any record other than being particularly interested in the music on it. The fact that playing the record on normal stereo equipment erases the unperceived quad information carrier, and thus effectively converts the disc to standard 2-channel stereo, is quite irrelevant to the choice of music. The advice is no different to dissuading a colourblind person from going to see anything but black & white movies, unless of course he is particularly interested in a film which happens to be in colour!

However, although the compatibility red-herring continues to impede the acceptance of four-channel discs for the mass stereo and mono market, the real blame for quad's failure lies squarely on the recording industry's bull-headed inability to agree on a universal system incorporating the best features of matrix and discrete encoding. Scheiber's original matrix system can be easily decoded using a two-channel amplifier and resistive matrix, and is perfectly compatible with standard two-channel stereo; the drawbacks of crosstalk between neighbouring speakers and antiphase signals at the rear are quite tolerable to 90% of four-channel listeners. In attempting to overcome these shortcomings Sansui's QS system sacrificed some stereo compatibility, while CBS/Sony's SQ sacrificed simplicity of decoding. Meanwhile, quite independently, JVC developed an elegant but expensive discrete system which, while delighting wealthy purists, left the majority of the four-channel audience unable to obtain any benefit from the wide range of CD-4 discs (notably the RCA label).

It would have been so simple—commercial politics apart—to have used a simple Scheiber encoding, with its limitations of crosstalk and phase, plus an additional rear-signal carrier as employed in the discrete CD-4 system. Then those dissatisfied with matrix performance could demodulate the carrier to retrieve the rear channels, and subtract these from the matrixed baseband signal to obtain the discrete front channels—a procedure which would add only a few cents to the cost of a CD-4 decoder. For FM radio, a second carrier could be added for the rear information, while the matrixed signal is broadcast on the conventional stereo signal. (A similar system, the Dorren quadruplex, is used in the USA though without the option of matrix decoding.) As for cassettes, where to put the extra two discrete channels remains a problem . . . but in any case, it is unlikely that the purists who insist on discrete decoding would regard cassettes, with their performance limitations, as a suitable source.

A few months ago, a "universal" quadraphonic system was rumoured in the press to be imminent, but I fear it is too late. The opposing factions in the recording world have cooked their own goose, and if you want a golden egg you'll need a silver spoon!

A. D. Mealing
Hornsby, NSW

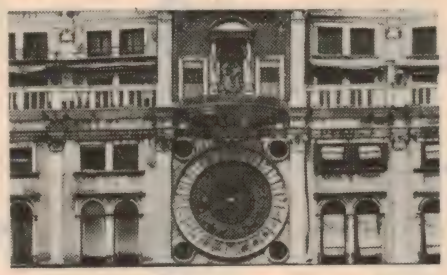
COMMENT: Surely you're splitting straws. People may buy particular discs (a) because of the contents and (b) because they happen to fit into a long-term equipment plan. We agree that the 4-channel situation got into a mess—for the precise reason that "commercial politics" could not be set apart, causing individual engineering groups to pursue their own thing!

Oldest digital clock?

In recent times, a great deal of interest has been focussed on the relatively new area of eletronic digital timekeeping, in fact, in just about every overseas and local electronic magazine a proliferation of digital clock integrated circuits are offered to the electronic constructor.

I, like many others interested in electronics, have been "bitten by the bug" and now own an impressive array of different types of electronic clocks; I even keep track of time during the day by means of my electronic digital wrist watch.

On a recent trip through Europe I found myself in St. Mark's Square in Venice and to my amazement found what must surely be the oldest digital clock in the world!



It is the St. Mark's Square Clock Tower which contains not only a digital time presentation (complete with Roman numerals), but also a 24 hour clock giving the angle of the sun and moon from the earth at any time of the day and night.

The designer of the clock must be forgiven certain errors in the design, such as the presentation of the earth as the centre of the Universe with the sun and moon revolving around it. At the time it was designed Copernicus had not worked out the present accepted theory of our solar system, and in fact had yet to be born.

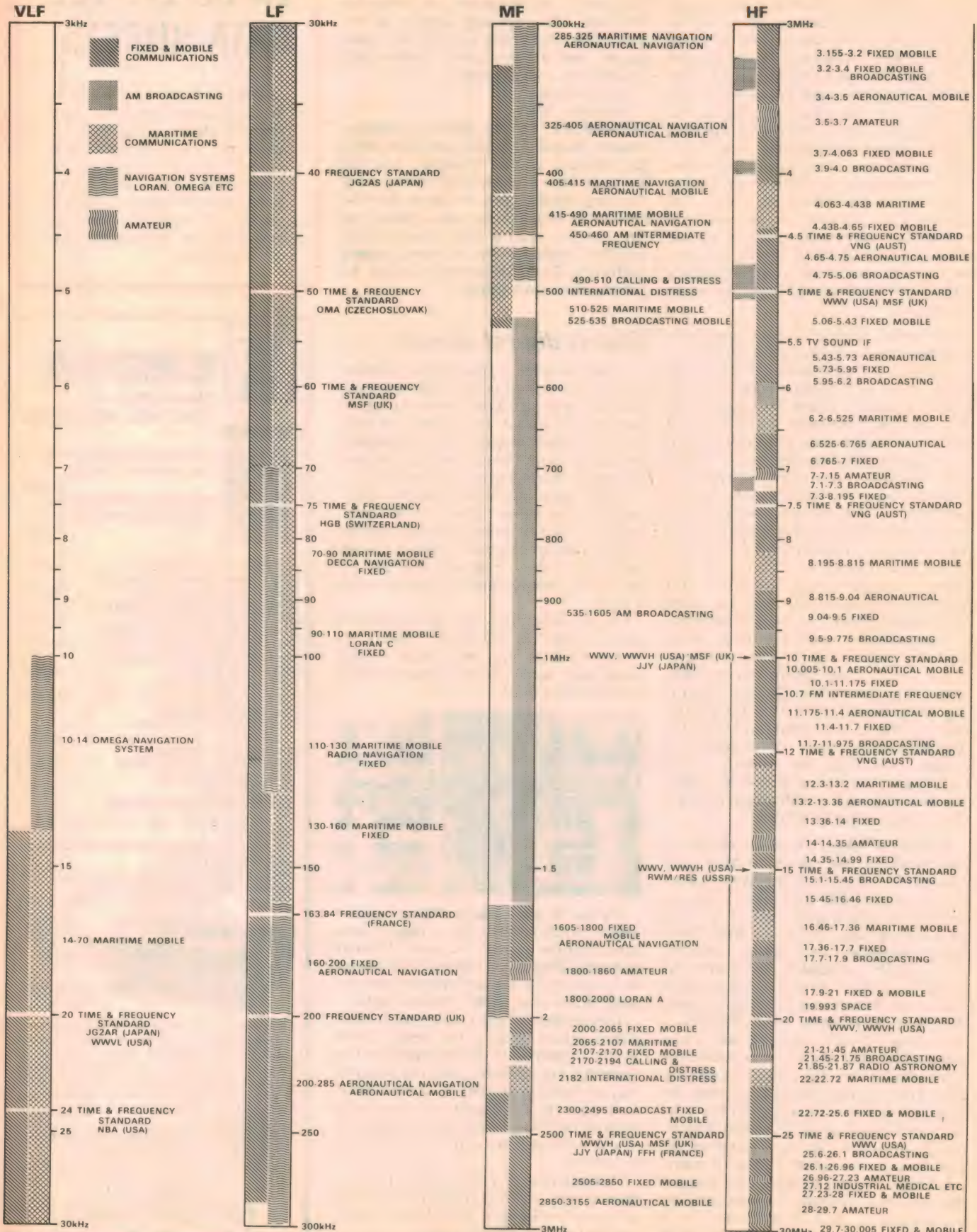
Perhaps one of your readers may be able to give us more details of this magnificent timepiece which was constructed almost 500 years ago!

E. Roberts
Rydalmere, NSW

EA REFERENCE DATA SHEETS

Overleaf you will find two further sheets of useful reference data. One is a sheet giving the basic specs for common signal and rectifier diodes, produced in conjunction with Dick Smith Electronics. The other is the first page of a chart showing the current usage of the electromagnetic spectrum.

FREQUENCY SPECTRUM



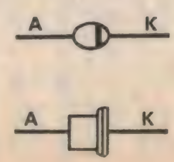
This table is based on information supplied by the Australian PMG's Department. It shows Australian allocations within the International Telecommunications Union Regulations. While broadly similar to allocations in other countries, they may differ in detail.

RECTIFIERS/DIODES

TYPE	MAT	V_R	I_F (A)	V_F	@ I_F (A)	I_R (μA)	@ V_R	USE
A 14 P	S	1000	2.5	1.25	2.5	0.5	1000	Transient Protected (Controlled Avalanche)
A 15 A	S	100	5	1.1	5	5	100	G.P. Rectifier
BYX21L/200R	S	75	25	1.2	25	1.1	75	Automobile H. Duty
EM 4005	S	50	1	1.1	1	5	50	G.P. Rectifier
EM 401	S	100	1	1.1	1	5	100	"
EM 404	S	400	1	1.1	1	5	400	"
EM 410	S	1000	1	1.1	1	5	1000	"
IN 4001	S	50	1	1.1	1	5	50	"
IN 4002	S	110	1	1.1	1	5	100	"
IN 4004	S	400	1	1.1	1	5	400	"
IN 4007	S	1000	1	1.1	1	5	1000	"
IN 5408	S	1000	3	1	3	5	1000	"
IN 5059(A14B)	S	200	2.5	1.25	2.5	0.2	200	Transient Protected (Controlled Avalanche)
IN 5060(A14D)	S	400	2.5	1.25	2.5	0.2	400	" "
IN 5061(A14M)	S	600	2.5	1.25	2.5	0.2	600	" "
IN 5062(A14N)	S	800	2.5	1.25	2.5	0.5	800	" "
MR 110	S	100	10					G.P. Stud Mount
MR 410	S	400	10					"

DIODES

	CASE	V_R	I_F (mA)	C_d (pF)	V_F	@ I_F (mA)	I_R (μA)	@ V_R	T_{rr} (nS)	USE	COMPARABLE TYPES
Germanium											
AA 119	DO–7	30	100	1.2	2.2	10	150	30		AM/FM Detection Point Contact	
OA 90	DO–7	20	45		1.5	10	450	20		G.P.–Point Contact	OA70, OA80
OA 91	DO–7	90	150		1.9	10	180	75		"	OA71,OA79, OA81
OA 95	DO–7	90	150		1.5	10	110	75		"	
Silicon											
BA 100	DO–7	60	90	25	.96	10	10	60		G.P. – Alloyed	
BA 102	DO–7	20		20-45	C_d ratio 1.4 @ 4/10 V/VV					Variable Capacitance	
BA 114	DO–7		20		.7	1				Bias Stabilizer	
OA200	DO–7	50	160	25	.96	10	.1	50		Small Signal–Alloyed	
OA202	DO–7	150	160	25	.96	10	.1	150		"	
IN 914A	DO–35	75	75	4	1	10	5	75	4	Small Signal–Switching	IN 4148
IN 4148	SD–5	75	75	4	1.	10	.025	20	4	"	IN 914A
5082-2800	DO–7	70	15	2	.41	1	0.2	50	0.1	Schottky (Hot Carrier) UHF Detector, Mixer, Switch	



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Electronics Australia | Dick Smith DATA SHEET

Another new design from Philips Elcoma Division:

A 30W 3-SPEAKER VENTED SYSTEM

Following the description of an 80-litre 3-way loudspeaker system in our recent "Year Book", we present details of a new 3-way ported system developed locally by engineers of the Elcoma division of Philips. At 60 litres, it is somewhat more compact and economical but is nevertheless capable of a very similar order of performance.

Somewhat smaller than their sealed "System 14" described in our 75/76 Year Book, the new Philips Elcoma "System 16" has an internal volume of 60 litres and is 66cm (26in) high. The general sound balance is similar and would be virtually indistinguishable if the option was exercised to use the somewhat dearer ADO210/SQ8 mid-range driver.

by PHILIP TRACY & HOWARD JONES*

It is over 10 years since Elcoma (then Miniwatt and Mullard) last published vented enclosure designs for loudspeakers from the Philips range. The main reason for this is that the designs published, until very recent times, have simply followed the European work on sealed systems.

In fact, the modern bass drivers in the Philips range all feature a low fundamental resonance and will therefore produce good results with a minimum of design effort in sealed enclosures. This is appropriate for the European market, which does not demand extreme bass response, but concentrates rather on a smooth response with low distortion.

It has become apparent that there is a demand from a significant sector of the Australian market for increased performance in the lower frequency range and the locally developed System 14, described in the 1975-6 E.A. Yearbook was intended to cater for this demand.

Following demonstrations with this sealed 12" enclosure system several comments were received to the effect that the achieved low frequency behaviour should be obtainable from an 8" driver in a properly designed—and smaller—vented enclosure. To gain more local experience with vented enclosure designs, Elcoma decided to investigate the design of a vented system around the AD8066W8 bass driver.

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The increasing acceptance of the design methods of Benson, Thiele, Small and others have made it much easier to predict and measure the behaviour of vented enclosure systems.

The AD8066W8 was measured to obtain its basic parameters and indications showed that an enclosure volume of around 60 to 80 litres should produce a smooth, extended low frequency response and that good matching to the midrange and tweeter would be possible. This is quite an important aspect as will be detailed later.

Market preference for small sized enclosures lead to the adoption of the lower limit of the volume range—60 litres.

ENCLOSURE DESIGN: A vented enclosure is tuned so that the "springiness" of the enclosed air resonates with the "mass" of air in the vent tube at around the fundamental resonance of the driver in free air. The speaker resonance was measured at around 43Hz and the enclosure in our final system 16 design is tuned to 38Hz.

Before proceeding to the actual enclosure design several measurements were taken on commercially available vented systems. Two systems tested had vent diameters of 75 and 90mm respectively and sinewave testing at a couple of watts in region of the vent resonance suggested the desirability of using a vent port of the largest practical diameter. The smaller vent showed definite "noise" caused by turbulence of the high velocity air movements in the vent. In the 90mm model the effect was still present, but this time barely noticeable. On this basis we specified the vent diameter to be around 100mm.

Such a specification at once determines the length of the vent tube for a given enclosure volume and resonance and indirectly determines the depth of the enclosure when the vent is located in the front of the cabinet. Indeed, if one aims to minimise coincident resonances by making the enclosure dimensions follow optimum ratios (say 0.6:1:15) this single specification of vent diameter imposes many constraints on the total design. It is necessary to balance this requirement against economic constraints such as efficient useage of timber from available sheet sizes and subjective styling requirements.

The resultant enclosure design, as illustrated, is considered to represent an acceptable balance with regard to technical performance and cabinet styling.

The AD8066W8 was measured to have an equivalent compliance volume of about 55 litres (as per Thiele and others) and a total Q in free air of about 0.55. This Q figure is somewhat above optimum for a critically damped response for an enclosure volume of 55 litres so some additional damping is required.

This damping cannot be achieved by the simple method used for sealed enclosures, i.e., filling the airspace with a lossy material such as Innerbond, because the prime effect of the resonant box would thereby be lost. Instead, local damping on the bass driver itself, in the form of two layers of 25mm Innerbond has to be fixed over the back of the speaker and well pinned to the front baffle. The rest of the box remains empty except for the usual lining with 20mm carpet underfelt glued or well pinned against the box walls to eliminate high frequency standing waves.

The prototype box was built and tested using the "nearfield" measurement technique described by D. B. Keele in the Journal of the Audio Engineering Society Vol. 22 No. 3 April 1974. This method gave good results in the development of

the closed box System 14 and was found to yield results on this vented system which agreed very closely with theoretical predictions. Basically, the vent output is measured and added to the driver output to obtain a resultant response.

Because low frequencies are involved and the vent is close to the driver, the phase relationship of the vent and driver must also be measured and vector addition of the output considered. It was verified that addition on the basis that the vent and driver are in phase above the box resonance and out of phase below this resonance gives a sufficiently accurate result. At the box resonance there should be minimal output from the driver and the peak vent output should be about -3dB relative to the driver output after allowance has been made for the difference in diameters.

(Scale factor is 20 log D_1/D_2 where D_1 and D_2 are the diameters.)

The measured resultant response is shown in the accompanying curves.

CROSSOVER DESIGN: On economic grounds the 5" AD5060 Sq. 8 midrange "squawker" was chosen for this system but there is no reason why the 2" dome AD0210 Sq. 8 should not be substituted if some improvement in midrange dispersion and transient response are considered to outweigh the increased cost. Both midrange units have very similar sensitivities. The well known AD0160T8 tweeter completes the 3-way system.

Again, a specially designed crossover is used which is very similar to that used with System 14 but with two major differences. The most important of these is that no resistive attenuation of the bass speaker is allowable. This is because the Q of the AD8066W8 is already higher than desirable and any series resistance will result in a peaked response around 70Hz which is where the upper impedance peak of the vented system occurs. As little as 0.5 ohms will give rise to an additional 1dB peaking. The 1.5dB peak in the response shown is already due in part to the 0.5 ohm resistance in the 2mH choke plus the 0.3 ohm resistance in the 6 metres of twin 23/.0076 speaker leads employed.

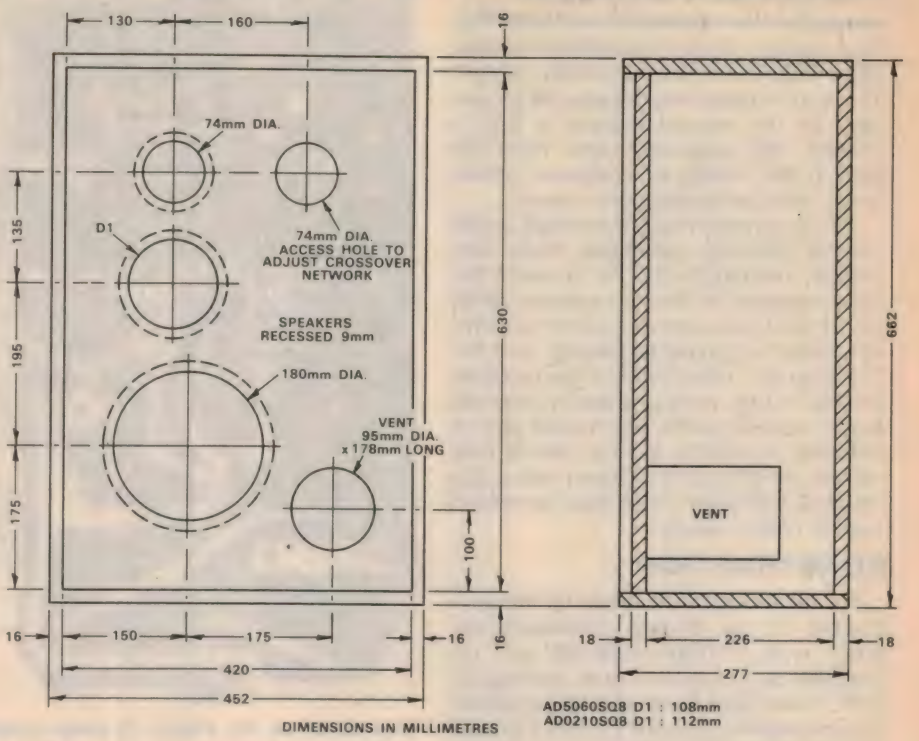
It should also be noted that, in any vented box system, the output impedance of the amplifier plays a much more important part in determining the overall response than it does with sealed box designs. It is important that the amplifier used with this vented design has a low output impedance (say less than 0.25 ohms) right down to at least 40Hz if the specified response is to be obtained. Long extension leads, small diameter leads and poor joints in leads must all be avoided if the driving impedance is to be kept low.

A second difference is that the crossover inductor used in System 14 "sees" a 5.6 ohms in series with a 12-inch speaker voice coil which has significant inductance near the crossover frequency. In this system the impedance is significantly lower and the 3mH has therefore been reduced to 2mH. The resonant "trap" above the crossover frequency has been retained.

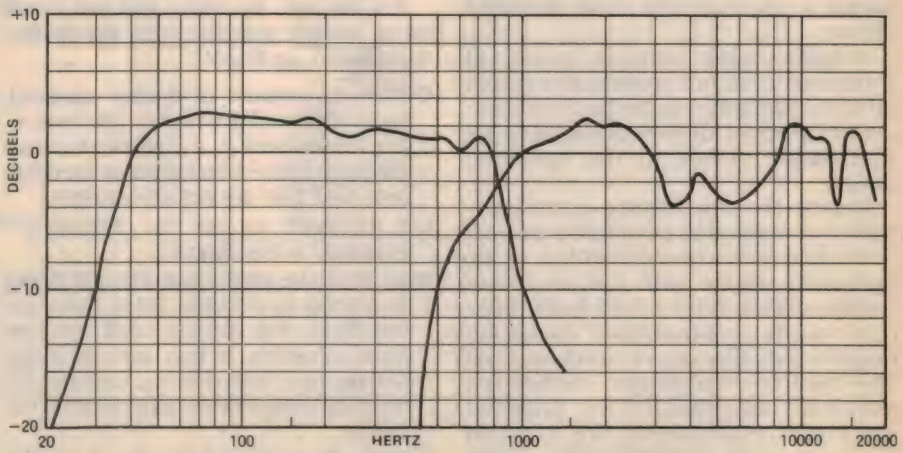
The midrange unit AD5060 Sq. 8 has a more extended upper frequency response than the 2" dome squawker and additional roll-off R-C components have been added to increase attenuation above 5kHz. The tweeter crossover and the level switches are the same as previously described in the January issue.

SUBJECTIVE EVALUATION: It was most encouraging to find that this new System 16 compared most favourably to the more expensive and larger System 14 in A-B listening tests. Overall, the tonal balance was very similar and the smaller

For readers with workshop facilities:



Dimensional drawings for the 60-litre "System 16" enclosure. Proportions could be modified slightly to suit timber sizes but the enclosed volume must not be changed. If the speakers are not recessed flush with the baffle, as per the dotted lines, the depth of the overlap for the grille frame may need to be increased. The constructional method—cleated, mitred or butted—can be selected to suit facilities available but all joints must be strictly airtight and speakers bedded down against adhesive foam or strip caulk.



Frequency response of the Philips Elcoma System 16, as determined by the nearfield measurement technique, with the midrange and tweeter level controls set in the "+" position. (Editor's note: possibly because of lobe effects, in a normal listening position on axis, our staff listening panel preferred the "0" position for the mid-range, and possibly for the tweeter as well.)

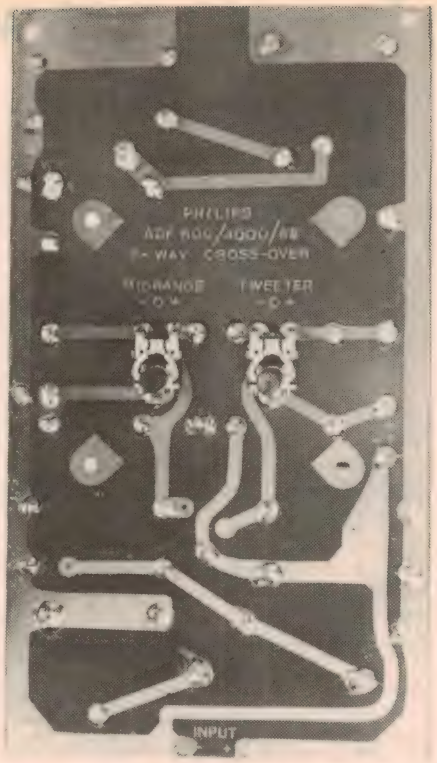
3-SPEAKER SYSTEM

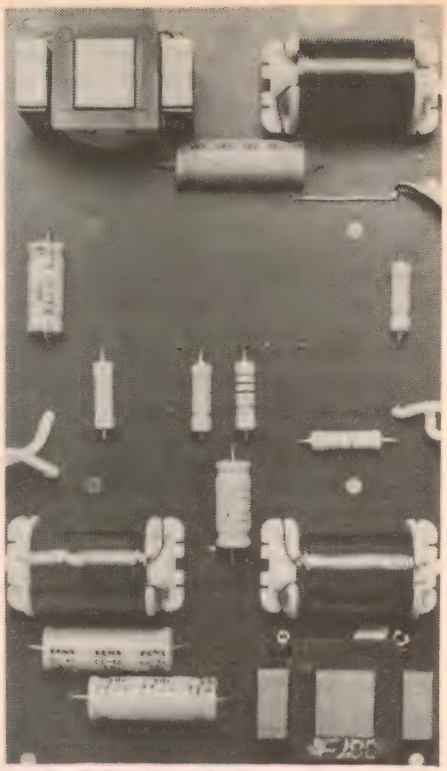
bass speaker showed no distress in handling high level low frequency signals. This is as it should be, because an advantage of the vented system is that it ensures high acoustic output from the port in the vicinity of enclosure resonance, while minimising cone travel.

On all normal program material, under normal listening conditions, there was virtually nothing to choose between the bass response of the two systems. With hand-picked source material—the occasional organ pedal passage and the "Earthquake" film theme—it was possible to detect some extra profundity from the larger, sealed system. This would almost certainly be due to the fact that it rolls off less steeply (12dB/octave) below the nominal 3dB down point than the vented system (24dB/octave).

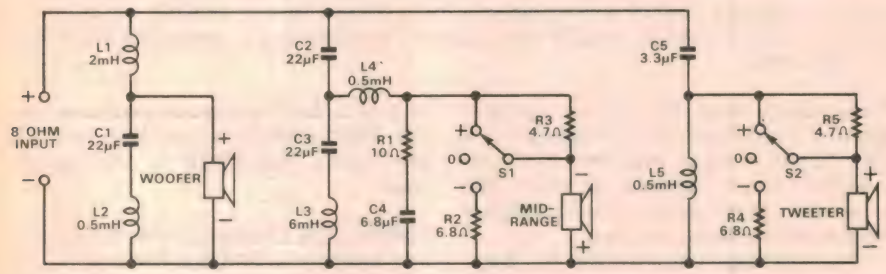
CONSTRUCTION

For those wishing to build up the new System 16, the Elcoma crossover network type ADF600/4000/8B will be available as a complete unit, built up on a PC board and fitted with flying leads. It is intended to mount behind a cutout in the front baffle, with the two miniature level switches accessible. Note that the interface must be rendered airtight by screwing the PC board down firmly against a circle of strip caulk provided with it.





Two views of the Philips Elcoma crossover network type ADF 600/4000/8B. The midrange and tweeter level switches are shown mounted on the copper side so that they are accessible when the board is screwed behind a cutout similar to that for the tweeter. The two higher value inductors are wound on bobbins on "E" laminations, in the interest of compactness and economy.



Circuit details of the crossover network pictured at top right. It carries the designation ADF 600/4000/8B and, while differing somewhat from that specified for the System 14, it follows a similar design approach. It can be used with the mid-range driver specified or the more expensive—and higher performance—AD 0210/SQ8.

A home-made network could, of course, be used but constructors would be faced with either bulky and costly air-cored inductors, or with the need to set iron-cored chokes to the specified values.

Elcoma are also looking at the possibility of marketing a complete pre-cut cabinet kit in the near future but, in the meantime, those with the necessary woodworking skills could build their own to the accompanying dimension diagram. Whether you resort to the cleat construction or use another method is a matter for individual choice, provided the basic requirements are met: an enclosure of the recommended volume and similar if not identical proportions, absolutely rigid and absolutely airtight, except for the vent tube of precisely the recommended internal length and cross-sectional area.

For the rest, the hints and tips could be as already published for the System 14 in the "Year Book":

Determine amount of timber required. Sizes indicated are metric (25.4mm = 1"). Pyneboard is a suitable material although other materials may be used, provided they are equally as rigid.

Cut the parts as per the dimensions indicated in the diagram.

Mark the holes on the baffle board, being as precise as possible. If the holes are too small, the speakers will not bed down properly. If they are too large, sealing may become a problem and the mounting screws may crumble the edges.

Check the correct position of the speakers by placing them on the board. Keep in mind that the loudspeakers should be mounted on the front of the baffle board to facilitate possible servicing.

Cut the holes for the speakers. If facilities are available, the baffle surface can be rebated to bring the flanges flush, giving a more professional appearance.

Fit and securely glue the vent tube in place, using enough glue to seal against air leaks.

Paint the entire visible surface of the baffle flat black to ensure that cutouts, etc, will not be visible through the grille cloth.

Glue and screw the battens to their respective panels. Remember that the baffle board is set back sufficient to provide a recess which accommodates the grille frame. Where battens supporting the front and back panels butt, make sure there are no gaps which could affect the final sealing.

Glue top, bottom and side panels together with woodglue (e.g., P.V.A. woodglue).

Coat underneath of speaker flange and recess in baffle board with a caulking compound. This will ensure an airtight seal as loudspeakers are screwed in place.

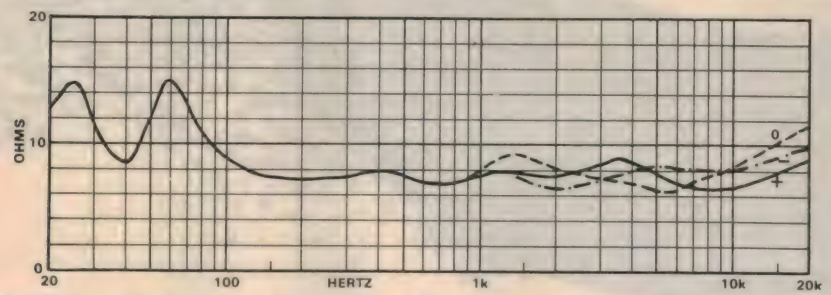
Mount the cross-over network on the back of the baffle board using the sealing strip provided to ensure an airtight seal.

Attach the leads connecting the loudspeakers and cross-over network, also the lead to connect cross-over network with amplifier. (Ensure correct phasing: the red dot on one connection tag of each speaker is the + connection.)

3-SPEAKER SYSTEM

Alternatively, the loudspeakers may be taken off the baffle board and fitted after completion of the box. This will eliminate the possibility of damaging them during construction of the box. In this case the connecting leads should be appropriately identified.

Glue and screw the baffle board into position. Fill in all holes and gaps to ensure an absolute airtight seal.



Overall impedance curve of the Philips System 16, with the midrange and treble switches set for 0, – and +. The nominal impedance is 8 ohms.

Drill a hole in the back panel and pass the connecting lead through it. Alternatively, a connecting tag panel may be used. Fill all holes with rubber cement such as "Mastix" to prevent airleaks.

Line the side walls and back with acoustic damping material. The preferred material for this system is fibrous carpet underfelt, either ¾inch thick or two layers of ½inch.

Glue the back panel into position and fill all remaining holes and gaps with woodfiller.

Assemble the frame for the grille cloth and staple or glue the grille cloth to it (blacken the frame prior to filling the cloth).

The completed frame should be a push fit inside the front of the enclosure.

Sandpaper all surfaces taking care to prevent dust going into the speakers.

The final step is veneering, painting or other finish, as preferred.

And here a few general points: The system as depicted has a nominal impedance of 8 ohms and is therefore suitable for use with most solid-state amplifiers. A version could be built with 4-ohm transducers but the crossover network values would have to be rescaled for the different impedance. Again, the design is valid only for the transducers actually specified; with other models or other brands, the end result would be indeterminate. Sensitivity is about average for a hifi speaker system and, in practice, it could be used in a domestic situation with a very modest amplifier (e.g. 6W per channel) up to at least 30W per channel, or higher if the amplifier is not consistently pushed to its limit.

CONCLUSION: A vented enclosure offers extended bass response without sacrificing efficiency and is an ideal choice for widerange twin-cone speakers with moderate cone resonance frequencies. In multi-speaker systems it becomes important to carefully choose the efficiencies of the individual drivers but, when the correct choice is made, a highly efficient system is obtained with maximum performance obtained from a given bass speaker.

The requirement on the crossover network and amplifier are more critical than for sealed enclosures and it becomes important to adhere closely to all specified components and enclosure dimensions.

The continuing application of objective measurement techniques is yielding very gratifying results and even in A-B testing this System 16 shows only very minor differences from the larger System 14, the differences being mainly attributable to the differences in midrange units chosen.

QUICK REFERENCE

BASS DRIVER/ENCLOSURE: Free air resonance 43Hz. Equivalent compliance volume 55 litres. Total speaker Q in free air 0.55. Internal volume of enclosure 60 litres (420 x 630 x 226mm). Less bracing, vent and speaker volumes, total 5 litres. Effective volume 55 litres. Enclosure resonance frequency 38Hz. Vent length 178mm. Vent internal diameter 95mm.

Lower cut-off frequency (–3dB) 38Hz. Level response (±1dB) 42Hz-800Hz. Enclosure lining—"Super" grade carpet underfelt (approx. 20mm). Additional damping 2 layers of 28mm innerbond 400mm x 400mm across back of bass driver and tacked to front baffle.

MIDRANGE DRIVER: AD5060SQ8 or AD0210SQ8 (see text).

TWEETER: AD0160T8.

CROSSOVER NETWORK: ADF600/4000/8B (complete with speaker leads and 6m of input lead).

POWER HANDLING CAPACITY: 30W (nominal) RMS.

IMPEDANCE: 8 ohms (nominal).

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AUSTRALIAN MADE

MODEL 466-80 WATTS RMS

SPECIFICATION

Nominal Diameter	38 cm (15")
Cone Type	Curvilinear, ribbed, integrated surround plus whizzer cone.
Voice Coil Diameter	6.4 cm (2.5")
Magnet Weight	6.0 kg (13.3 lbs)
Flux Density	13,600 gauss
Total Flux	255,000 maxwells
Frequency Range	50-6000 Hz
Continuous Power Handling	160 watts RMS
Recommended Amplifier Power	80 watts RMS
Main Applications	Electric piano, vocals, full range program material
Depth	16.0 cm (6.3")
Baffle Hole Diameter	
Front Mounting	36.6 cm (14.4")
Rear Mounting	35.6 cm (14.0")
Net Weight	9.5 kg (21.0 lbs)

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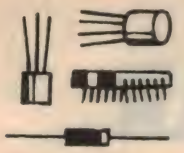


What's new in Solid State

A short introduction to opto-couplers

Although opto-couplers or opto-isolators have been around for a couple of years now, they were initially rather expensive, and were used mainly in rather specialised applications. More recently the prices have been tumbling, however, and people are starting to put them to use in all sorts of new applications.

There is currently a lot of interest in the devices, and we have received quite a few requests for information on them—particularly for clarification of some of the parameters quoted in manufacturers' specs, like current transfer ratio.

In response to these requests, we are reproducing here this month a short but very informative article on opto-couplers which was originally published in Siemens' Components Report. Here is the article, reproduced by kind permission of Siemens Industries Limited:

The most commonly used optically coupled isolators consist of a GaAs (gallium arsenide) luminescence diode as emitter and a silicon phototransistor or a silicon photodiode as sensor. The digital or analog signals transmitting the information are conveyed by optical means. The electric signal will be converted by the emitter into an optical signal which, in turn, will be reconverted into an electrical signal by the sensor. Infrared emitters operating in the 950nm range are preferably used. The infrared radiation hits the photo transistor or diode, which generate currents approximately proportional to the radiant power. An outside influence to the luminous flux is not possible, because of the closed case. A characteristic feature of the optoelectronic coupler is the galvanic separation of photodiode and phototransistor, thus admitting a voltage difference of up to several kV.

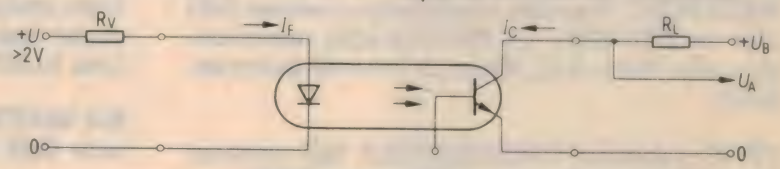
Features of IR emitters

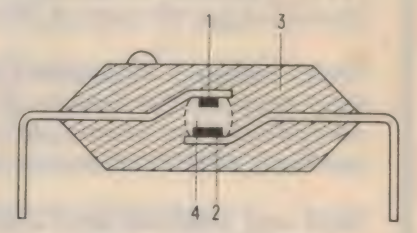
The infrared light-emitting diodes are operated by direct currents in the forward direction. Values of 3 to 10mA are currently used. The currents are stabilized in advance by insertion of series resistors or other current regulating circuits. The forward voltages are in the order of 1.3V. A reverse voltage rating of 3V is quoted in most of the cases, although typical devices will withstand above 20V. The radiant power is approximately proportional to the on-state current.

Features of silicon photosensors

The typical current amplification of silicon phototransistors is about 300. The reverse voltage achieves values of 30V, in special cases even towards 100V. At a collector current of 2.5mA, the saturation voltages yield less than 0.3V which will allow the optocoupler generally being TTL compatible.

Optocouplers with silicon photodiodes are preferably used if analog transmissions with minimal distortions





Above is the general circuit configuration used for opto-couplers, with a typical construction shown at right. 1 is the emitter, 2 the sensor, 3 the opaque body and 4 the transparent insulating medium.

are needed. The photo current is then strictly proportional to the incident radiation, provided that the signal current is superimposed upon a relatively high direct current.

In the case of an extended base terminal of the phototransistor, its collector-base path can serve as photodiode.

As the silicon phototransistors and diodes generate an "injected" photo current, the load resistor *RL* may be located either in the collector circuit or in the emitter circuit (signal reversing) without producing a feedback coupling. But this is only true if the base is not connected.

Current transfer ratio

The relationship between emitter input current (If) and sensor output current (Ic) is given by the current transfer ratio (Ic/If), also termed transmission ratio, transmission factor or transmission efficiency. This is usually expressed as a percentage, although due to the amplification provided by a phototransistor as the sensor, the figure can be higher than 100%. In fact the range is very wide, varying from as low as 0.1% for a unit with a photodiode sensor to as high as 600% for a unit with a phototransistor. In general, optocouplers with short switching times tend to have a smaller current transfer ratio than those with longer switching times.

Switching time

IR emitters having short switching time yield a radiance efficiency that is about tenfold smaller than that of those with a long switching time. Rise times are 10 to 100ns for fast IR emitters and approx. 1us for slower types. The latter suffices for most of the applications.

Silicon phototransistors have longer switching times as a consequence of undesired negative feedback via the collector-base capacitance and the final transit frequency ft. In order to achieve short switching times, the load resistances should be chosen as small as possible. The rise times increase in proportion to the current amplification. Darlington transistors are, therefore, still slower. But the switching time may be reduced by inserting active load resistors and applying capacitance compensation.

Silicon photodiodes have negligibly small switching times compared to IR emitters. In this connection, the *RC* product of load resistance x photodiode capacitance must be considered.

Isolation voltage

There is no precise definition of the isolation voltage. In view of the indefinite meaning of the isolation voltage Vis, SIEMENS give the *test voltage* corresponding to the admissible difference voltage between input and output of the optocoupler. The absolute value—up to several kV—depends essentially on the case structure and the emitter-sensor spacing. The isolation resistance may reach more than 10^{11} ohms.

Applications

The electrical isolation provided between emitter and sensor of an optocoupler gives the component great versatility. They have mainly been used to date for electrical separation in situations where there is indefinite grounding conditions, as well as for achieving isolation between high and low voltage circuits. Some examples are:

- Electrical separation in automation, particularly to isolate computers and logic from power circuits.
- Replacement of polarised relays in teleprinter circuits.
- Electrical isolation in medical equipment.

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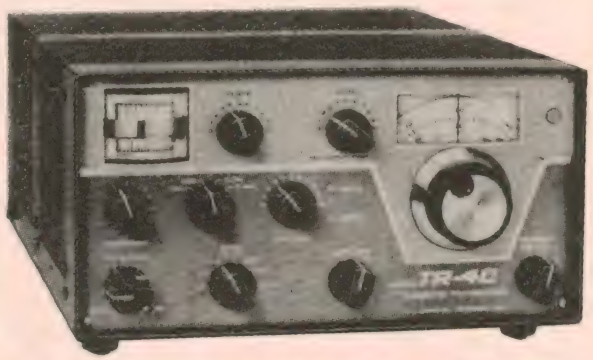

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Circuit & Design Ideas

Conducted by Ian Pogson

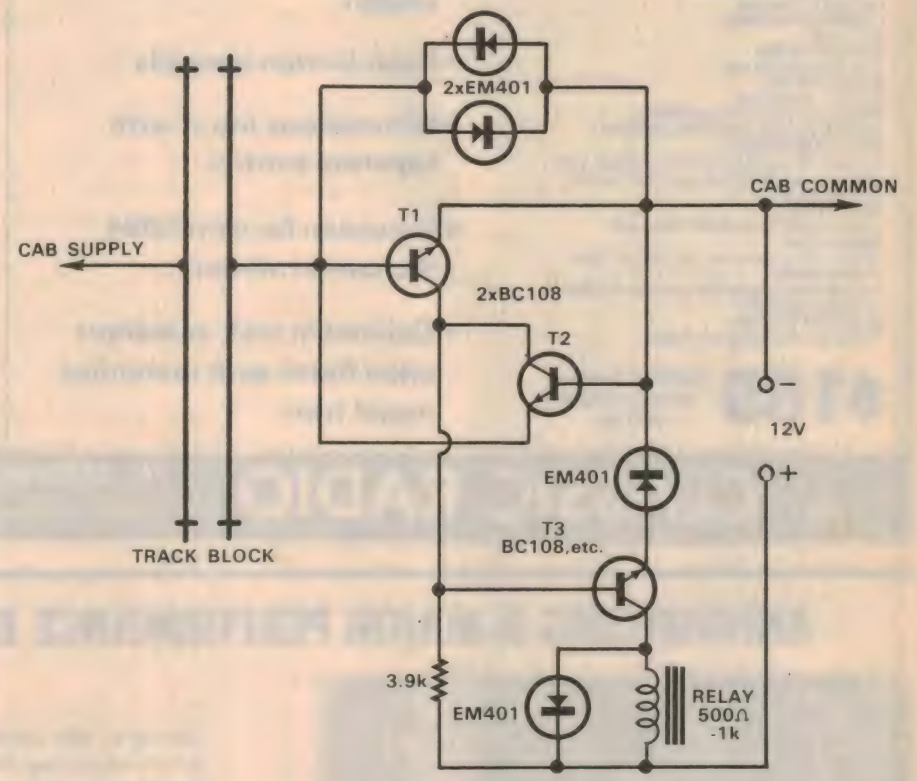
Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

Model railway signalling sensor

A major requirement in any model railway system is a means to detect the presence of a train on a particular track section. This information is then used to perform various automatic functions, such as setting signals behind the train to red and/or "killing" the section of track immediately behind the train.

One method of detection is to fit miniature reed switches into the track and suitable magnets under the locos which will operate the reeds. Such an arrangement can form the basis of a very effective signalling system in conjunction with simple "flip-flop" circuits. ("Projects & Circuits" p75.)

In the very small "N" gauge (9 mm) systems it may be difficult or impossible to fit suitable magnets to the very small locos, and some other means of sensing is required. This alternative approach should prove very useful to others with similar systems.



As may be seen in the circuit, loco current is passed through the emitter-base junction of one or the other transistor (T1 or T2) depending upon train travel direction (forward or reverse). This current turns on T1 or T2 and so T3 is biased off and the relay drops out. With this circuit, the added feature of fail-safe is built in. The circuit could also use power transistors, such as 2N3055 etc, without the bypass diodes. This adds to the cost but loco current would have to be considered in such a modification.

To ensure that a train is detected whilst standing in a section, I have the throttle slightly on (approximately 1.5V) by adjustment of the cab circuit. This voltage is too low to move the loco. I have operated this circuit for over two years without a single failure.

(By Mr W. J. Graham, 4/16 Burwood Road, Hawthorn, Vic. 3122.)

Editorial note: The exact role of the two EM401 diodes shunting the base-emitter junctions of T1 and T2 may be an open question, with all the implications of two diodes being connected in parallel. However, it works for our contributor and we leave any possible alternatives to other readers who may wish to make use of the idea.

Battery condition indicator

This is a neat comparator circuit which can be fitted to battery operated equipment to maintain a check on battery voltage. One reason for using this device is that if the equipment draws a very low battery current the voltage drop caused by the increase in the internal resistance of the battery as it runs down will be relatively small. The equipment may function properly even though the battery may be virtually exhausted. There is a very real risk that the battery may leak while it is still in use.

The risk can be avoided by using the battery condition indicator, as it may be set to indicate a dangerously low battery voltage which may not be much lower than the ordinary working voltage. The device can also be used in equipment having a zener diode stabilising circuit with no means of monitoring the zener voltage. It is quite possible for the battery voltage to fall to a level which is too low to allow the zener diode to exert control.

A 741 op amp is employed as a voltage comparator. The non-inverting input is connected to the zener reference source. We will assume that the device is set to indicate a fall in voltage to 10.2V and that the reference voltage is 5.1V. R2 will be adjusted so that the voltage at the inverting input is half the supply voltage. The output voltage of the IC is equal to the potential difference across its two inputs multiplied by its voltage gain. The 741 has a voltage gain of thousands, and so a potential difference of less than a millivolt is required across the inputs to result in the output swinging either fully positive of fully negative.

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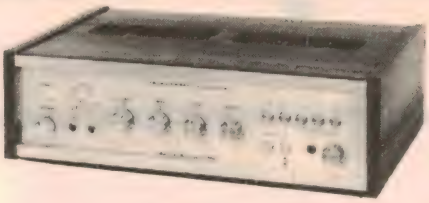

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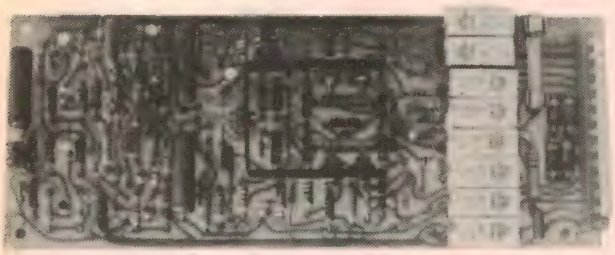

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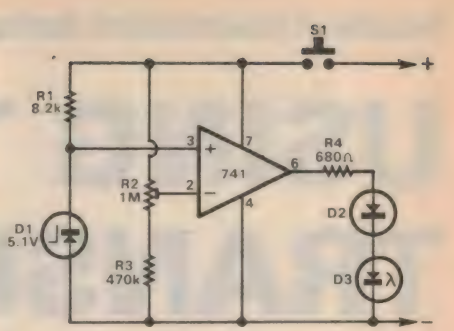
the inverting input will be positive of the non-inverting input. The output will be swung fully negative and the LED will not light. When the supply falls just fractionally below the 10.2V level the IC inverting input will be slightly negative of the non-inverting input and the output will swing fully positive. The LED will light, indicating that the supply voltage has fallen to the pre-set threshold level. The LED can be made to light at other voltages by adjusting R2.

The drop of about 0.6V across D2 reduces the minimum standing output voltage to a level which is just too low to light the LED. D2 may be any silicon diode capable of passing about 20mA. Although the current drain of the battery condition indicator is not excessive, it is shown as being connected to the supply via a push-button switch. Alternatively, the indicater can be connected across the supply permanently. Current consumption with the LED not lit is about 0.5mA at 6V, rising to about 1.5mA at 15V. When the LED is lit the current is about



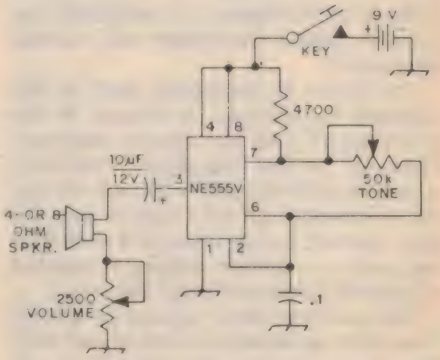
4.5mA at 6V, rising to about 14mA at 15V.

(By P. R. Arthur, in "Radio & Electronics Constructor".)

Code practice oscillator

While looking for a code practice oscillator to be used for group instruction, I discovered yet another use for Signetics NE-555V timer chip. The unit is wired on perforated board along with a 9V transistor radio battery. The unit is housed in a plastic box. The key is enclosed in this box with just the paddle sticking out. No switch is included, as no current is drawn except when the key is depressed. The output tone can be varied in frequency from a few hundred to a few thousand hertz, and volume can be adjusted to a comfortable level for a room full of people.

(By Jim Burney, WA5YFL, in "QST".)



Discriminator displays 1st of 4 responses

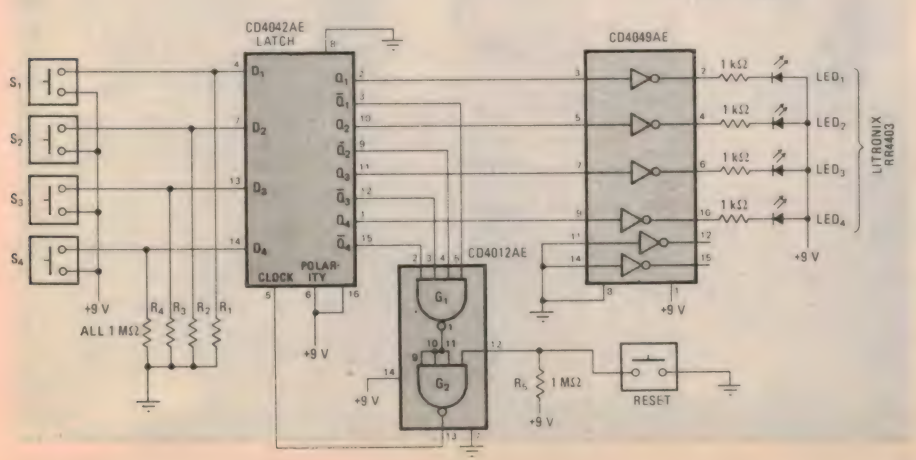
A first-response discriminator, which turns on a light indicating the first switch to close and simultaneously locks out the other switches, can be useful in sports, games, behavioural learning studies, and experiments in physical science. The circuit shown indicates which of four switches closes first. It uses three low-drain CMOS integrated circuits and a 9V radio battery.

When the push-to-close switches S1 to S4 are open, inputs D1 to D4 to the 4042 quad latch are low. Therefore outputs Q1 to Q4 are low, and $\overline{Q}1$ to $\overline{Q}4$ are high. These four high inputs to NAND gate G1 make G1 low and G2 high. The high output from G2 is applied to the clock input of the latch. With the clock thus enabled, the outputs of the latch can follow the inputs.

If switch S1 is closed, D1 goes high and therefore Q1 goes high, allowing diode LED1 to light. Simultaneously, $\overline{Q}1$ goes low, sending G1 high but G2 and the clock input of the latch low. The clock low locks the latch so that D2, D3 and D4 no longer control Q2, Q3 and Q4. As a result, even if S2, S3 and S4 is closed, the corresponding LED does not light. The circuit is reset by momentary closing of the reset switch to set G2 and clock high. If S1 to S4 are open, Q1 to Q4 go low for the next trial.

Expansion of this circuit to handle N inputs is straightforward. Only two NAND gates are required but one of them must have N inputs.

(By John S. French, in "Electronics".)



Practical electronics demonstration:

USING THE TRANSISTOR

by A. J. LOWE

This Teach Yourself chapter turns back to the transistor; not to see what it does, as that was demonstrated in an earlier board, but to see a particular application of the transistor—as a switch. This application accounts for countless millions of transistors, in integrated circuits, in digital computers and control equipment.

The layout of the board, built to the standard dimensions, is shown in the photograph and the circuit diagram. There are no real difficulties in the construction of this board. A 1.5 volt AA size cell is mounted on the board to provide base current, but an external 6 volts battey, such as a lantern battery, is needed to provide current through the lamp.

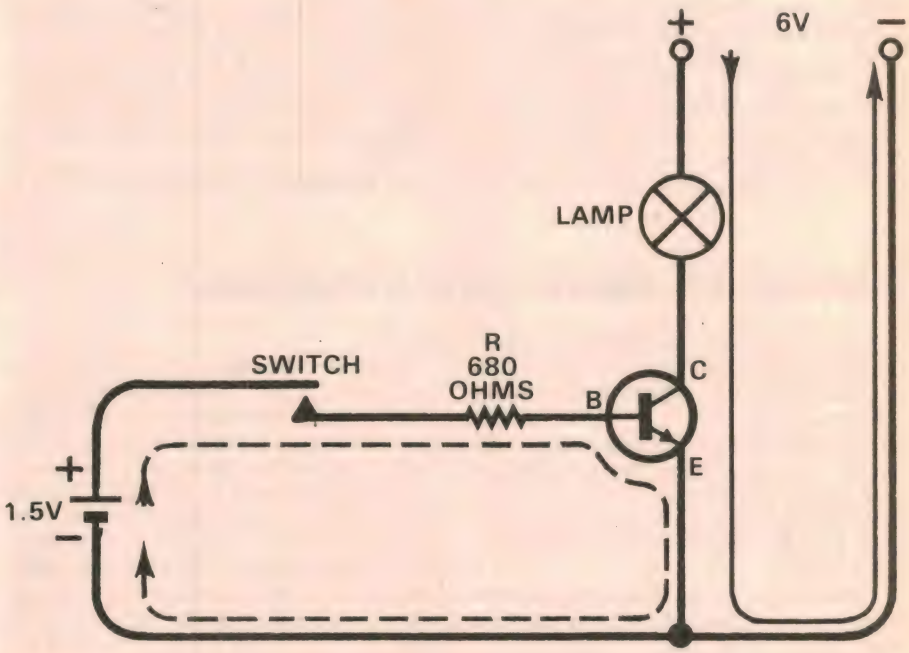
The switch is simply a piece of springy brass strip, soldered to a nail at one end. The free end may be pressed on to another nail below it to complete the base circuit.

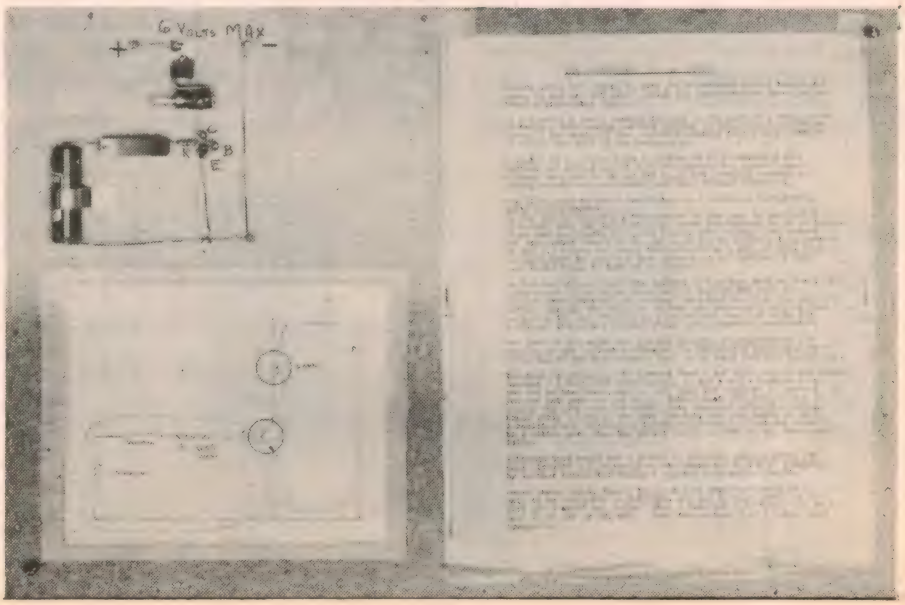
The resistor R, which limits the current in the base should be selected so that the transistor in use is turned fully on. This means trying various resistors and using the highest value which results in a minimum voltage appearing across the transistor from collector to emitter—usually between 0.2V to 0.5V approximately. This can be done without soldering the resistors—use a pair of leads with a clip on each end.

Do NOT leave your multimeter connected between collector and emitter while you change resistors, because when the base circuit is opened the voltage will jump to six, and if your meter is on a lower range it may be damaged.

If you don't have a multimeter simply select the value of resistor R as follows. Start with a high value, say 2700 ohms, and note that the lamp turns on only dimly. Reduce the value of R until no change in brightness is perceptible. At that value the transistor is fully turned on. The lamp used is a 6V 0.1 amp bulb used in bicycle tail lamps.

It's worth while familiarising yourself with the transistor characteristics demonstrated on this Teach Yourself Board, as all the remaining boards include working circuits which depend on the use of transistors as switches.





PARTS LIST

1 npn transistor BC209 (National) or similar
1 lamp holder
1 lamp 6 volts 0.1 amp (bicycle tail lamp)
1 resistor to be selected—see text
1 1.5 volt AA size cell
1 6 volt battery
Nails, wire, aluminium, brass

THE TRANSISTOR AS A SWITCH

Before using this board be sure you understand what a transistor does. If not— study the board "What A Transistor Does".

As you should know, a small current flowing in the base-emitter circuit of a transistor controls a much larger current flowing in the collector-emitter circuit. The ratio of the collector current to the base current is called the GAIN of the transistor.

A switch is a device which is either ON (ie carrying full current, having almost zero resistance, and almost zero voltage across it) or OFF (ie not carrying current, having a very high resistance, and full voltage across it).

So to use a transistor as a switch we must arrange that:—

1) For the ON condition, the current in the base is sufficient to ensure that the transistor can carry the current to be switched (ie the load current)—with almost zero voltage across the transistor from C to E. If we wanted to switch a load current of, say, 0.5 amp and had a transistor with a gain of 100, then we would have to supply a base current of 0.5 divided by 100, ie .005 amp to turn it on fully.

2) For the OFF condition the current in the base must be zero. It takes about 0.7V to push current through the base of a silicon transistor and any voltage less then 0.7 will not send any current through the base. So to turn the transistor off, we need to reduce the base voltage to a value less than 0.7 for a silicon transistor and 0.4 for a germanium transistor.

Now look at the model and circuit diagram. A lamp needing 0.1 amp is in the collector circuit. The transistor gain is about 90, so the base current must be at least 0.1 / 90 = .0011 amp.

The base is supplied with current from a 1.5V cell on the board. Connect a 6V (NOT MORE) supply to the + and — terminals at the top of the board, making sure that the polarity is correct. If you are not sure ask for help. Notice that when you connect the supply the lamp does not light. But, when you press the switch in the base circuit, the lamp turns on fully. A resistor is included in the base circuit to limit the current to a little more than the amount needed to turn the transistor on fully.

Although this model has a switch in the base circuit there are many circuits—in calculators etc—where the switch is replaced by another transistor inside a digital integrated circuit.

Learn these words: When a transistor is turned on fully it is said to be SATURATED or BOTTOMED, and the voltage across it is very low—about 0.2 to 0.5V. When a transistor is turned off it is said to be OFF or CUT OFF. Check the voltage C to E across this transistor.

FURTHER SUGGESTIONS

1) If you have a multimeter measure the voltage from base to emitter of the transistor when it is on. It will be about 0.7.

2) Measure the current through the transistor collector when the lamp is lit, by connecting your multimeter in the 6 volt battery circuit. It should read about 01. amp.

3) Measure the current through the base to emitter, by connecting your meter across the switch—without pressing it. It will read about .001 amp, ie about 1 milliamp.

4) Now think about the power lost in the transistor. It is carrying 0.1 amp and has a voltage across it of 0.2, so the power lost is 0.1 x 0.2 = .02W (20mW). This power appears as heat and must be dissipated or the transistor will overheat. A mere 20mW is easily dissipated but, in other applications, a lot more heat can be generated and suitable cooling has to be provided.

An Introduction to Digital Electronics—2

Basic logic elements

When designing digital circuits, and also when analysing their operation, it is very helpful to think in terms of logic function. To do this effectively one needs to have a clear understanding of the fundamental logic functions AND, OR and NOT, together with their derived functions NAND, NOR and exclusive-OR.

by JAMIESON ROWE

As we noted in the first chapter, Claude Shannon showed that the concepts developed by George Boole and Augustus de Morgan for dealing with class relationships could be used almost without change to analyse and design digital circuits. An important implication of this is that no matter how complex a digital "logic" circuit may be, it is always possible to break it down into a combination of certain fundamental logic operations. These fundamental logic operations or "functions" are effectively the building blocks from which digital circuits and systems are assembled.

There are really only three of these fundamental logic functions, known by the labels AND, OR and NOT. Although some fairly simple combinations of these are also used as basic building blocks, AND, OR and NOT are the only really fundamental logic functions.

Because they are so basic, the three functions are not very hard to understand once you get used to the concepts involved. But, because they play such an important role in all digital circuits and systems, it is essential that you do really understand them right from the start—otherwise the rest of digital electronics will never really make much sense. So we are now going to look at the three functions in some detail.

Basically the logic label AND is used to describe any situation where one event or state-of-affairs occurs only if there is a combination or "conjunction" of certain other events or states of affairs. Putting it another way, any situation where something happens only when certain conditions are met simultaneously can be described as an example of the AND function in operation.

Let's look at a simple example. In the lamp switching circuit of Fig. 1, it should be fairly obvious that current will only flow through the lamp if all three switches are closed at the same time. It is therefore true to say that the relationship between the lamp being lit and the three switches being closed is an example of the logical AND operation.

Now look at Fig. 2, which is again a very elementary switching circuit with three switches and a lamp. Here the three switches are in parallel, so that if any one of the switches is closed, current will flow and the lamp will light. The relationship between the lamp being lit and the three switches being closed is now obviously different from that in Fig. 1. In fact, it corresponds to the second fundamental logic function, the OR operation.

The logical label OR is used to describe any situation where the occurrence of one event or state-of-affairs depends on the occurrence of any one, but at least one, of a group of other events or states-of-

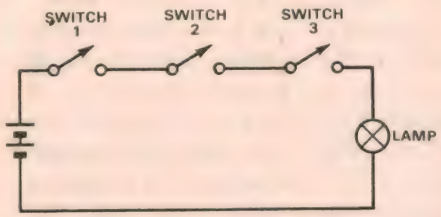


FIG. 1

affairs. In other words, the OR function deals with situations where all that is necessary for something to occur is that at least one of a group of conditions has occurred.

Note that the OR function describes a situation where a number of possibilities can result in the controlled event occurring: either only one of the conditions can apply, or two, or any number up to and including the case where ALL conditions apply. In a sense, therefore, the OR function "includes" the AND function—or, more strictly, it covers situations where the single set of conditions defined for the AND function is one of a number of possibilities, any of which is sufficient for the controlled event to occur.

Another important thing to notice is that, in another sense, the AND and OR operations are really the opposite sides of the same coin. Look again at Fig. 1, but this time visualise the controlled event not as being the flow of current and lighting of the lamp, but as the interruption of current and extinguishing of the lamp. It should now be apparent that, instead of illustrating the AND function, it will illustrate the OR function. This is because the lamp will extinguish if any one or more of the switches is opened.

Now look at Fig. 2, and again visualise the controlled event as being the extinguishing of the lamp. Fairly obviously, when considered from this angle, the circuit is now illustrating the AND function instead of the OR function. All three of the switches must now be open before the lamp will extinguish.

In other words the operation of the circuit in Fig. 1 is equally capable of representing either the AND or OR functions, depending upon the way we choose to look at it. And the same applies to the circuit in Fig. 2, the only difference being that the relationship between the two logical functions and the electrical events is reversed.

You can see from this, I hope, the way in which AND and OR are in effect only the opposite sides of the same logical coin. This is in fact a very important concept; it forms the basis of the Boolean algebra law known as "de Morgan's theorem", as we shall see later on.

The other point which hopefully, has also become apparent is that the relationship between an electrical circuit and the logical function it is seen to perform is not fixed, but capable of being arbitrarily assigned. In other words the circuit

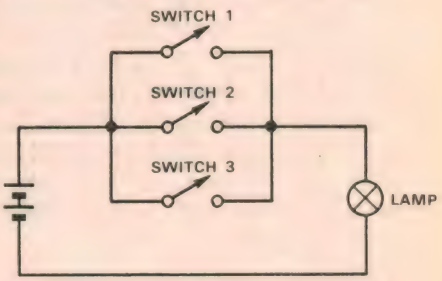


FIG. 2

in Fig. 1 could be used to perform either an AND or OR function at will, simply by selecting the appropriate relationships between the electrical events and the logical information "quantities" they are used to represent.

This is a very important concept to grasp, because it means that physical circuit modules used as logic elements are never rigidly fixed in terms of their logic function. A module can be used to perform a variety of functions as desired, simply by adopting the appropriate interpretation of its electrical behaviour.

Selecting the appropriate logical interpretation of a circuit's electrical behaviour is usually called "assigning the

logic convention''. We will discuss this very powerful designer's technique later on.

Incidentally, although Fig. 1 and Fig. 2 both show three switches used to represent three logical ''input'' quantities or conditions, neither the AND nor the OR function is restricted to three inputs. Both apply for any number of inputs from two upward.

The third fundamental logic function is called the NOT function, as mentioned earlier. This is rather different from the AND and OR functions in that it labels any situation where one event or state-of-affairs is basically the logical opposite or ''complement'' of another. In other words, a situation where one thing happens whenever another does not, and vice-versa.

A simple circuit which we can use to illustrate the NOT function is shown in Fig. 3. Here when the switch is open, the transistor is able to conduct and current will flow through the lamp. But if the switch is closed, the transistor will have no forward bias and will be cut off, extinguishing the lamp.

The relationship between the lamp being lit and the switch being closed represents the NOT function. But note that just as with the AND and OR functions, whether or not a circuit is seen to act in this way depends completely on the way we interpret its electrical behaviour in logical terms. In other words, upon how we assign the logic convention.

So that if we again consider Fig. 3, but this time look at the relationship between the lamp being extinguished and the closing of the switch, the circuit will not be seen to perform the NOT function at all. The same is true if we look at the relationship between the lamp being lit and the switch being opened.

On the other hand if we look at the fourth possible combination, the relationship between the lamp being extinguished and the switch being opened, it will again be seen to perform the NOT function. It's all a matter of interpretation, or the way we choose to assign the logic convention.

Although the logical function effectively performed by any particular electrical circuit is a matter of interpretation basic logic functions themselves—the AND, OR and NOT functions—do have quite fixed definitions. Before going any further we had better look at these definitions.

In order to do this we should first clarify what we mean by the input and output quantities of a logic element. From the logical point of view, these are not electrical quantities like current or voltage, but logical statements. These statements can have two possible values—truth and falsity. If a statement is true, it is said to have a logical value of 1; if it is false, it is said to have a logical value of 0.

Alphabetic characters can be used to represent logical statements, and this makes it possible to express logical truth or falsity in a convenient shorthand way. If a statement represented by ''A'' is true, for example, this can be written

$$A = 1$$

similarly if a statement represented by ''B'' is false, this can be written

$$B = 0$$

The logical definitions of the AND, OR and NOT functions are given in terms of input and output statements, and their truth or falsity.

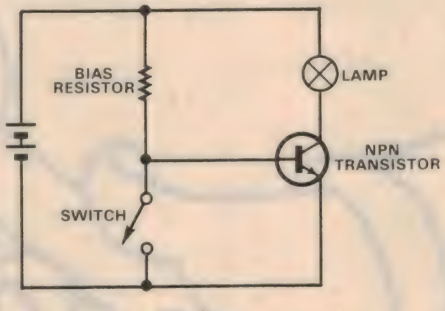


FIG. 3

Thus the AND function is defined as the function whose output statement is true (1) only when all appropriate input statements are also true, and false (0) if any or all of the input statements are false.

A very concise way of expressing this definition is by means of a ''truth table''. This is simply a table showing all of the possible combinations of truth and falsity of the input statements, and the corresponding values of the output statement. Here is the truth table definition of a three-input AND function, using A, B and C to represent the input statements, and Z to represent the output statement:

A	B	C	Z
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

As you can see, it shows all of the possible combinations of truth and falsity for the three input statements, and also shows that the output statement is true only for one combination: the one where all inputs are true. For all other combinations the output is false.

Like the AND function, the OR function is also defined logically in terms of the truth and falsity of input and output statements. In this case, the OR function is defined as the function whose output statement is true (1) if any one, or more, of the input statements is true, and is false only if all of the inputs are false.

Here is the truth table definition for a three-input OR function, using the labels A, B, C and Z as before:

A	B	C	Z
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Note that here, the output statement Z is false only when all three of the input statements are false. It is true for all other combinations.

The logical definition of the NOT function again involves the truth and falsity of its input and output statements. The NOT function is defined as the function whose output statement is true (1) when its input statement is false (0), and vice-versa. Here is the definition in terms of a truth table, using A to represent the input statement, and Z to represent the output statement:

A	Z
0	1
1	0

Logical relationships like those involved in the three basic functions we have just defined can also be conveniently expressed symbolically, in the form of expressions and equations which look rather like those of conventional algebra. In fact this is the basis of Boolean algebra, as we will see later.

Thus the relationship between the output and inputs of a three-input AND function may be expressed by the equation:

$$Z = A.B.C.$$

where the dots represent the AND function itself, so that in words this equation says ''Z is logically equivalent to A-and-B-and-C''.

Similarly the relationship between the output and inputs of a four-input OR function may be expressed as:

$$Z = A + B + C + D$$

where the plus signs represent the OR function itself, so that in words this equation says ''Z is logically equivalent to A-or-B-or-C-or-D''.

The relationship between output and input of the NOT function may be expressed as:

$$Z = \overline{A}$$

where the ''bar'' over the A signifies the logical opposite of A, or its complement, so that in words the equation says ''Z is logically equivalent to the complement of A''.

These, then, are the three fundamental

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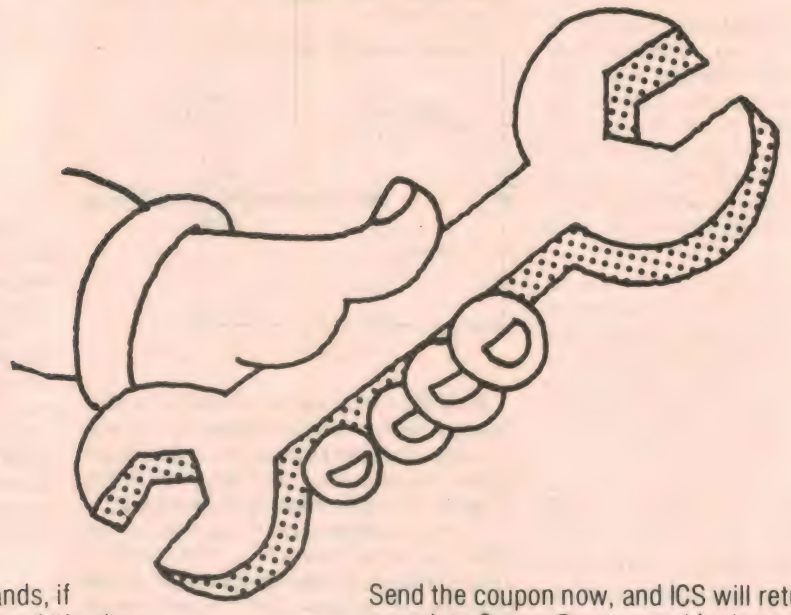

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logical functions, from which it is possible to synthesise any more complex logic function.

For convenience, however, some of the simple combinations of these fundamental functions are often also regarded as "basic" logic functions, and used in practical logic circuit modules.

One of these derived functions is the NOR function, which was originally called the "Pierce arrow function" after its originator, C. S. Pierce. This is simply a combination of the OR function and the NOT function—or if you like, it is an OR function which has the complement of its normal output.

The truth table definition of a three-input NOR function is:

A	B	C	Z
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

as you can see, the output is true only when all inputs are false, and is false for all other combinations.

The relationship between output and inputs of a three-input NOR function may be expressed as:

$$Z = \overline{A + B + C}$$

which says in words "Z is logically equivalent to the complement of (A or B or C)".

A second derived logic function is the NAND function, which was originally called the "Sheffer stroke function" after its originator, H. M. Sheffer. This is similarly a combination of the AND and NOT functions—or an AND function whose output is the complement of a normal AND gate output.

The truth table definition of a three-input NAND function is:

A	B	C	Z
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

here you can see that the output is false only when all inputs are true, and is true for all other input combinations.

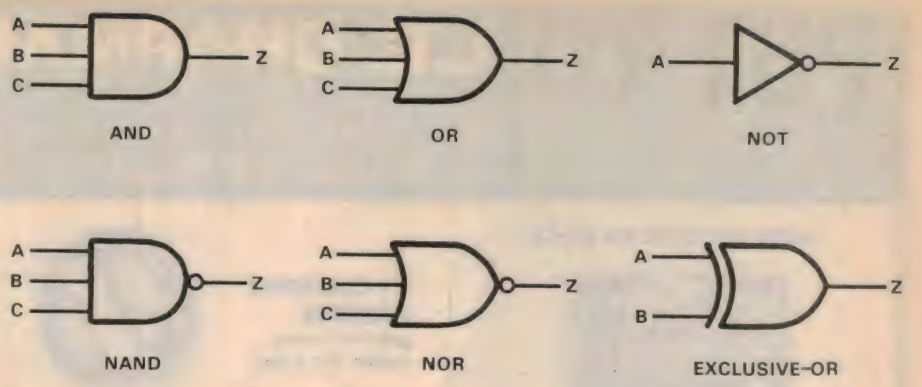

FIG. 4 BASIC LOGIC FUNCTION SYMBOLS

The output-input relationship of a three-input NAND function may be expressed as:

$$Z = \overline{A.B.C}$$

which says in words that "Z is logically equivalent to the complement of (A and B and C)".

The NOR and NAND functions are very often used as the basis for practical "building block" logic circuit modules, because it happens that either one can be used to synthesise virtually any complex logic function. This is because they both incorporate two of the fundamental functions—and as we noted earlier, AND and OR are really the opposite sides of the same logical "coin".

A third derived logic function you may come across later in digital electronics is the exclusive-OR or "ex-OR" function. This is a function whose output is true if one AND ONLY ONE of its inputs is true, but false if either none of the inputs is true, or more than one are true.

The truth table definition of a two-input exclusive-OR function is:

A	B	Z
0	0	0
0	1	1
1	0	1
1	1	0

As you can see, the output is true only when a single input is true, and false for the other combinations.

The input-output relationship of a two-input exclusive-OR function may be expressed as:

$$Z = A \oplus B$$

where the plus sign enclosed by the small circle represents the exclusive-OR function itself. In words, this equation says "Z is logically equivalent to (A or B, but not both)".

The six logic functions we have looked at in this chapter are normally regarded as the basic components from which digital logic circuits are assembled. Circuit modules which perform the AND, OR, NOR, NAND or exclusive-OR functions are usually called "gates", while those which perform the NOT function ,are known as "inverters".

Incidentally it is possible to combine an exclusive-OR function with a NOT function, to produce an "exclusive-NOR" function. As you might expect, the output of this function is false if one and only one of the inputs is true, but is true if either none of the inputs is true, or more than one are true.

You might care to try working out the truth table definition of such an exclusive-NOR function, as an exercise, and compare it with that given for the exclusive-OR function.

When designing or analysing the operation of a digital logic circuit or system, it is convenient to think at least initially in terms of the logic functions performed rather than the actual circuitry. Instead of a circuit diagram, one draws or refers to a logic diagram, which has symbols showing the logic functions being performed.

The logic symbols most often used to represent the six basic logic functions we have looked at in this chapter are shown in Fig. 4. Note that these symbols strictly represent logic functions, not particular circuit modules. However in practice they are often used to represent particular modules or gates, by assuming that a certain logic convention has been assigned. We will look at this in more detail in the next chapter.

A final point. The basic logic functions we have looked at in this chapter form the basis of what is known as "combinational" logic. Circuits using combinational logic alone achieve a desired result instantaneously, using only a combination of these basic functions.

While combinational logic may be considered the backbone of digital circuits, there are many situations where the desired result cannot be achieved easily using combinational logic alone, or where the desired result itself is not simply a single event, but a series of events occurring one after the other. In such circuits it becomes necessary to supplement the basic logic functions with other elements, whose behaviour involves time.

Examples of such elements are flip-flops and monostables, which we will meet in later chapters.

Digital circuits involving these elements along with the basic logic functions are said to perform "sequential" logic as well as combinational logic.

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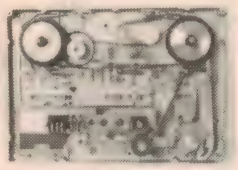

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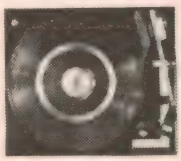

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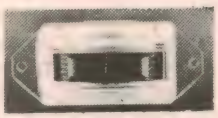

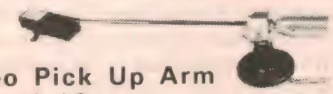

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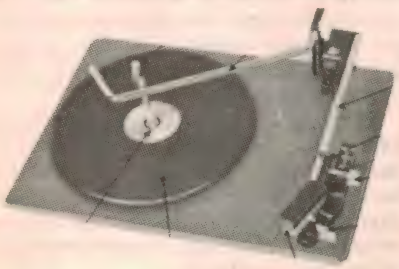

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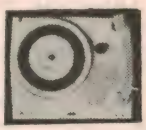

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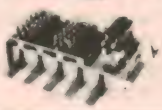

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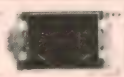

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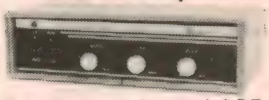

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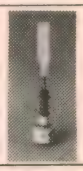

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MOUSSORGSKY—Boris Godounov. Opera edited for the most part by Rimsky-Korsakov. Nicolai Ghiaurov (Boris) with Galina Vishnevskaya, Martti Talvela and many others with the Vienna Boys' Choir, Sofia Radio Chorus, Vienna State Opera Chorus and the Vienna Philharmonic Orchestra conducted by Herbert von Karajan. World Record Club Stereo No. R 02214-5-6-7. (Four discs in box with English/Russian libretto.)

There are two reasons why I am reviewing this work at greater length than usual. First, in my opinion it is one of the greatest operas ever written, and secondly there is nothing in the accompanying libretto to hint at its unique history of many-handed alterations and, according to some opinions, mutilations. Thus there are four different versions of the work—Moussorgsky's original, two revisions by Rimsky-Korsakov, and another re-orchestrated by the late Dmitri Shostakovitch.

The most commonly used is one of the Rimsky versions though even with this one, made popular by Chaliapin in the title role and later recorded by Christoff, the original order of the scenes is sometimes changed.

So that the star could be in at the death, so to speak, the opera ends with the death of the Tsar and not the original revolution scene which finishes with the Simpleton lamenting the fate of the oppressed people of Russia. Though the composer's politics were a bit confused his sympathy was obviously with the people of that vast unhappy country.

Most often used is what might be called the standard version of the Rimsky revisions. Another Rimsky revision, that recorded here, includes a curious scene outside St. Basil's cathedral in Moscow during which Boris conducts a highly improbable dialogue between himself and the Simpleton. This scene was interpolated and orchestrated by Ippolitov-Ivanov, but the rest is Rimsky.

Then there is the composer's original version, orchestrated by himself and first made available by the efforts of a strange partnership between Stravinsky and Ravel in the 1900s. This version was given by the Elizabethan Opera Company some years ago and conducted by the Italian-domiciled Australian Denis Vaughan.

Although I had long advocated performance of this version I must confess disappointment when I heard it. Before this experience I agreed with many musicians that a great composer's work should not be meddled with, especially by that interfering old man Rimsky. He seemed to be of the opinion that because Moussorgsky was a drunkard he didn't know what he was doing.

I first thrilled to Boris in the standard version as presented by the Beecham Opera Company in London during World War I with the fine American bass Robert Parker in the title role. I have heard this edition on stage and records countless times and always thought it a work of supreme genius. Here are no gods and goddesses, no flashy sword play. Instead it is fundamentally an opera about people, real people, amiable, angry, cunning, noble, cruel, ambitious and rascally; in fact a work vividly alive in its many faceted characterisations. The chorus, too, has a life of its own, alternately fickle, vengeful and reverent. Genius shines from every page.

The version under review encompasses most of these factors with the addition of the St. Basil scene. It also includes the love scene between the Pretender Dmitri and a Polish princess, Marina. This scene was added by Moussorgsky himself when the original opera was criticised because of its lack of love interest. It has frequently been criticised as being Italianate in style and for that reason anomolous to the rest of the score though I must confess that I find it in parts very beautiful indeed. It is, however, a little disappointing as presented here because neither principal is very pleasant to listen to.

Marina is sung by that fine soprano Vishnevkaya—the wife of the great cellist Rostropovitch—whose voice some years ago when she visited Australia with her husband was as straight as a sword. But since then it has hardened and developed that wide vibrato common to so many Eastern European female singers. Her lover, the Pretender Dmitri is sung unimpressively by tenor Ludovico Spiess whose production sometimes introduces a Bayreuth bark, sometimes a tearful quality reminiscent of the late Gigli, and at others wobbles with a pretty wide vibrato.

But let's start at the beginning of this recorded set. To my mind Karajan is much too suave in his treatment of the opening crowd scene, ignoring the hidden violence in the music and the oppressive bullying of the political police—yes, they even had them in Russia way back in the 16th century. And this is followed by the usurper Boris' coronation scene in which Karajan never manages to achieve the glorious blaze of colour that should embellish it, though it is the Vienna Philharmonic Orchestra he is conducting and has a fine chorus at his disposal. The latter sounds a little too much like a well drilled pratorio choir. Later, however, Karajan catches the raw spirit of the opera and in the Garden (love) Scene wins some wonderful sound from the VPO.

Boris is played by Nicolai Ghiaurov in a quite wonderful characterisation, but in terms of the Chaliapin tradition his voice, though always enjoyable to listen to, has a baritone-like quality more in keeping with Moussorgsky's original creation. But this does not prevent him from delivering some spine-chilling scenes, both vocal and dramatic that should thrill all those who hear him. He is in turn strong, frightened, as uncertain of action as Hamlet, but generally noble in intention and a loving father to his two children. Martti Talvela's fine bass sound is a little young and fresh for the aged, monkish chronicler Pimen, although always musically admirable. His effortless production is a joy to listen to.

The drunken, rascally friar Varlaam is particularly good in what is probably the greatest drinking song ever written. His companion, the quieter Missail (Milen Paunov) provides an effective foil to the boisterous Varlaam. The drunken rumblings of Varlaam against the innkeeper's whispered instructions to Dmitri about how to find a secret track from the Lithuanian frontier into Russia, where he hopes to seize the throne from Boris, is a beautifully balanced exercise in conducting of the highest order. The innkeeper, Margarita Lilowa, is quite adequate if one ignores the abovementioned vibrato common to Iron Curtain sopranos.

There is an enchanting scene between Boris' children in their nursery although the nurse's story about the gnat, with which she seeks to amuse the royal children, is a little heavy handed. However, the "clapping" game that follows is very good indeed. Then comes Boris' great entrance, with his gentle, wise counsel to his son, full of wisdom and affection, and most moving in dramatic context. There is, by the way, an awkward but I suppose inevitable turn over here.

You then have Boris' horrifying hallucinations during which he is haunted by an imagined appearance of the child Tsar, whose murder Boris has contrived

in order to attain the throne. Here is Ghiaurov at his most eloquant. And here Karajan enters completely into the spirit of the composer's intentions. He balances voice and orchestra to perfection.

The singing of the chorus in the famous Polonaise is unimpressive, though Karajan's vital treatment of the rhythm is masterly. Then follows the lovers' scene in which the VPO is at its very great best despite the disappointment incurred by the two singers. The council chamber scene in which both sides of the ruling parties produce a splendid antiphonal effect is all one could desire, and the following entrance of the haunted Boris really harrowing. But I thought his sly advisor, Chuisky (Aleksei Maslennikov), could have been made a little more slimy. The bustle of the Peasants' Revolution is grand and the opera ends with the Simpleton's song of despair for the fate of the Russian people.

Now if the criticisms I have made about some of the aspects of this set might put you off buying it, forget them. Contradictory as it might sound, this set is a very fine Boris indeed. I urge anyone who can spare the modest investment for this four-disc set at its very reasonable club price to acquire one without delay.

★ ★ ★

RAVEL—Concerto for Piano and Orchestra. Piano Concerto in D for Left Hand and Orchestra. Hanae Nakajima (piano) with the Nuremburg Symphony Orchestra conducted by Gunther Neidlinger. Piano Concerto in G with the same artists. Colosseum Stereo SM 538.

This is a new label—at any rate to me—and seems to be of West German origin. In the G Major I sometimes found the balance between orchestra and soloist a little bit precarious. For that matter, the internal balance of the rest is not always entirely satisfactory either. Moreover the Japanese pianist sounds a little more idiomatic in her part then does the orchestra which often has a tendency to sound metronomic. There is, too, some unwanted reverberation at times.

The sound has a very wide, almost embarrassing range. To make the very quietest passages comfortably audible you have to make the fortissimos close to uncomfortably loud. Ms Nakajima plays the long solo at the beginning of the sound movement with impressive elegance, followed by a flute whose performance on the whole is first rate except for a rare straying off pitch, an incident that might easily be attributed to some carelessness in the processing of the original tape. I enjoyed, too, the Finale delivered with well pointed rhythmic vigour. Here and there throughout the concerto the wood wind sounds a little too close to the mike, especially a particularly strident piccolo part.

I enjoyed too the pianist's playing of the D major—for left hand only—in which despite the hard tone of her instrument, she sounded more at home than in the G Major. The alla marcia section is full of brio and high spirits. It too has attractively accented rhythm.

I have no idea of the price of this disc, but can positively state that at any price it faces fierce competition from other performances of the same two works.

★ ★ ★

LUTOSLAWSKI—Concerto for Orchestra.

JANACEK—Sinfonietta. Chicago Symphony Orchestra conducted by Seiji Ozawa. World Record Club Stereo R 02181.

Polish composers, among the most important of which I include Lutoslawski and Penderecki, seem to have the knack of writing immediately accessible music without deserting altogether current musical thought. Thus, even at first hearing, I found the Lutoslawski Concerto very exciting indeed. The composer never ventures very far from tonality—or perhaps polytonality would be a more precise term.

In the concerto under review the composer seems to keep all his instruments well within their normal compass, though the work must be very much less than easy to play. However, you will not hear any of the current "effects", such as using the cellos as percussion instruments or the piano making noises by slamming the lid down.

There is a delicate, quicksilver-like scherzo taken at demanding speed. This is interrupted by a Janacek-like trio in which brass instruments make ejaculatory sounds against the rest of the orchestra playing a broad melody that I found quite entrancing. The scoring is always brilliant, as it should be for concertos for orchestra (remember Bartok's?).

Roughly seven years separate the ages of Janacek and Lutoslawski—Janacek was the elder, a fact which many avant-garde critics might use to Lutoslawski's disadvantage, claiming that he should have advanced further forward to 12 tonalism than he does here. He should not, they might argue, still be writing easily understood music. It seems paradoxical to write that Lutoslawski's complexities are simple, but they are in a traditional manner. The precision of the playing is excellent, an important feature in a work so demanding of perfectly clean entrances and releases.

Despite its being a favourite of mine I found the Janacek Sinfonietta rather less enjoyable. Everything is a bit too burnished for this rough-edged composer who had no stylish precursors nor any followers of importance. Janacek's orchestration relies very much on the use of primary colours. His efforts to blend orchestral timbres are rare. He has, of course, lyrical interludes—the exquisite Andante in the Fifth Movement, is one.

Elsewhere his insistent repetitions have a peculiar effect on the listener. This is not at all unpleasant but produces a tightening of the nerves. In an entirely different context you might experience the same effect with Ravel's Bolero. Both the works reviewed here are very clearly recorded and offer an abundance of orchestral detail. Together they make an excellent coupling for those whose taste for contemporary music still pays allegiance to somewhat earlier days.

Mozart—String Quartets Vols. 2, 3, 5 & 6

MOZART—String Quartets Vols. 2,3,5 and 6. The Bulgarian State String Quartet. World Record Club Stereo Nos. R 00328; WRC 4613; WRC 4694 and R 00645.

This group used to be called the Dimov Quartet, after the name of its leader Dimo Dinov, until it was made flag-bearer for all Bulgarian string quartets. It has won acceptance in most musical circles though these are the first recordings I have heard. On the whole they are by no means disappointing with good ensemble and tone. Their style too is admirably consistent, changing when necessary from that of the early quartets to the deeper, more thoughtful later ones.

Six discs are required to complete the set, of which I have only four. And in order to fill the record surfaces to best advantage you will notice that they are not assembled in chronological order.

It will be obvious that I cannot deal with such a huge corpus in detail. That would require many pages. After the early quartets each has a character of its own. So it is with reluctance that I can only make this very cursory assessment of a collection of such magnitude.

In a collection of this size it is inevitable that some of the quartets will win approval at the expense of others. Moreover, some buyers might already own performances by different groups—the Amadeus, for example—that they might think more to their liking. However I can recommend this set on the consistent excellence of the presentation, though without pinning myself down to reckless approval of every item. I don't know if the full Amadeus set is still available. There are examples in it I personally prefer, but by no means all. However, if you are laying the foundations of a quartet library then, I recommend the collection under review, especially when the modest club price is considered. The Bulgarian State String Quartet, by the way, will be visiting Australia for Musica Viva later this year.

Lighter Side

Reviews of other recordings

Devotional Records

SHARE IT BROTHER. The Good Twins. Stereo, Singcord ZLP-927S. (From S. John Bacon Publishing Co., 12-13 Windsor Ave., Mt. Waverley, Vic 3149. $6.95.)

If the title "The Good Twins" seems a trifle odd for a brace of Gospel singers, it is readily explicable: they are indeed twins and their actual names are Dwight and Dwayne Good. In the jacket notes, well known Gospel composer and musician John Peterson commends them for a string of qualities like earnestness, vitality, warmth, etc. . . . and musicianship! In fact, they live up to his description, with a program of Gospel duets with a clear message and smoothly sung against a driving instrumental and percussion background:

Share It Brother – In Pleasant Places – Don't Remove My Crosses – I've Got A Reason To Live – Jesus Is Still Wonderful – God's Stubborn Love – He's The One – Spend A Little Time With Jesus In Prayer – Turn Around – Try A Little Love And Kindness.

Don't be surprised if the titles are unfamiliar to you: five of them are original compositions by Dwayne Good; the other five are new ones from the pen of John Peterson. But they should have an immediate appeal to all age groups and would be well worth a second look by groups searching for new Gospel material. (W.N.W.)

★ ★ ★

WHEN WE WERE YOUNG. The Ramblin' Strings. Stereo, Art Records AST 506. (From Advent Radio Television Productions, 150 Fox Valley Rd, Wahroongah 2076.)

Recorded at the Sydney studios of EMI, this is another album from the Adventist environment at Wahroongah, Sydney. The jacket is endorsed "Christian songs for children of today and yesterday" and, in this context, it is a quite charming effort. Children's voices feature just enough to lend an authentic atmosphere but overall, the arrangements and presentation exhibit a very high order of musicianship.

The titles: Happy Day Express – Jesus Loves Me – Mary's Boy Child – Jesus Bids Us Shine – Oh Friend Do You Love Jesus – Away In A Manger – Try A Little Kindness – Open Up Your Heart – The Boat On Galilee – The Night Watch.

A local recording, the quality is excellent and, If you have an interest in children, or work with them, I can thoroughly commend it. (W.N.W.)

★ ★ ★

MUSIC FROM ST ANDREW'S CATHEDRAL. Stereo, Unison Productions ULP-056. (From normal record houses $4.99 or direct from Unison Productions 118 Terry St, Rozelle, 2039, plus 60c P&P.)

Of more than usual interest, this is really a keepsake album of one of Australia's notable churches: St Andrew's Anglican Cathedral in Sydney. It is presented in a tasteful double-fold jacket with pen drawings of features in the cathedral, a brief history of the building, a tribute to John Antill (one of the Cathedral Choir's "old boys"), a message from Dean Lance Shilton, and acknowledgement of the organist and assistant organist, choir and soloists.

Recording engineer Malcolm Abel told me that he spent over a year assembling the items for the album – a program that provides about an hour of playing time. Side 1 is devoted mainly to the boys' choir and Christmas carols, while side 2 features the full male choir and more general devotional items. The massive twin organ is not forgotten, however, and features in two solo voluntaries, as well as for choral accompaniments, while the album begins and ends with the Cathedral's fine carillon.

The dynamics give evidence of a purist approach on the part of the recordist. The opening tracks are very restrained and, if your turntable has any rumble, you'll certainly hear it. But then the organ solo "Westminster Carillon" produces a veritable tornado of sound as, no doubt, it would have done in the cathedral itself.

But, whatever the level, the recording is superbly intimate and clear, catching every little hesistation that reveals the choristers and soloists as real people involved in an act of worship.

If you have any interest in – or empathy with – the cathedral witness and worship, this album would be an excellent investment. (W.N.W.)

★ ★ ★

IN THE GARDEN. Norma Zimmer, with orchestra conducted by Ron Huff. Stereo, Word, WST-8641-LP. (From Sacred Productions Aust., 181 Clarence St., Sydney and other capitals.)

Mentioned on other occasions in these columns, Norma Zimmer is an established American Gospel singer, with a gentle soprano voice and an intimate style, which is particularly evident in this program of predominantly traditional Gospel songs:

He Touched Me – Sweet Hour Of Prayer – But For The Grace Of God – Rock Of Ages – How Great Thou Art – What A Friend We Have In Jesus – In The Garden – The Lord's Prayer – There Is Something About That Name – Softly And Tenderly.

With a good but restrained orchestral backing, the songs proceed in a completely unhurried fashion, that will please those who know the hymns and who want to dwell on the words. But, on the rising "beat" generation, it could have a somewhat soporific effect. An imported American pressing, the quality is completely clean. (W.N.W.)

Instrumental, Vocal and Humour

GREATEST HITS OF THE 60's. Vol II. Arthur Fiedler and The Boston Pops. RCA Red Seal ARLI-0509.

The untiring Arthur Fiedler does it again with an easy to listen to dozen hits of the 60's, with titles like: The Shadow Of Your Smile – Georgy Girl – Theme From 'Exodus' – Mame – By The Time I Get To Phoenix – Up, Up And Away

Reviews in this section are by Neville Williams (W.N.W.), J. Rowe (J.R.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.) and David Edwards (D.W.E.).

– Cabaret – A Man And A Woman – Java – Days Of Wine And Roses – The Fool On The Hill – Yellow Submarine.

The quality and effective use of stereo certainly leaves no room for complaint. A pleasant record for dining or just plain relaxing in the evening. (N.J.M.)

★ ★ ★

MOVIE THEMES, 101 Strings, arranged by Les Baxter. Alshire S-5324 Astor Release.

With the big orchestral sounds of the '101 Strings' group, movie theme buffs should gain plenty of enjoyment from the following dozen themes from movies of recent times: The Godfather II – Airport 75 – Lenny – Lara's Theme – Murder On The Orient Express – Love Beat Of The City – Earthquake – Chinatown – Towering Inferno – The Grande Ball – Tender Mist – San Francisco At Night.

The sound is the usual 'lush' sound, seemingly so popular these days, recorded to a good technical standard. Ideal background music for that quiet dinner at home! (N.J.M.)

TV THEME CASSETTE

TV THEMES. Strings Unlimited Orchestra. Stereo, Astor Musicassette BCT-5233.

I guess that most TV series watchers concentrate their attention primarily on the lead characters and on the situations in which they find themselves nightly. The theme music is in the next layer down—part of a familiar pattern, but almost unconsciously so. That is, until it is isolated as here and presented as a sound-only program. As such, it makes quite acceptable popular orchestral listening and it certainly obliges the Strings Unlimited Orchestra to match the mood of some of television's happening people.

The themes: Hawaii Five-O – F.B.I. – Ironside – Mystery Magazine – Run Alice Run – Kojac – Theme From M.A.S.H. – All In The Family & Those Were The Days – Little House On The Prairie – Concrete Forest.

Technically the stereo separation is pronounced and the general sound quality up to normal cassette standards. Whether you would prefer to spend your dollars on a program of TV music or something else from Astor's Musicassette library is up to you. (W.N.W.)

ADRIAN FORD, Piano Solos – NICK BOSTON'S Colonial Jazz Band. Festival Harlequin L-25119.

At the special price of $3.99, jazz lovers get their money's worth indeed. Side one has Sydney born pianist Adrian Ford, with Nick Boston's Colonial Jazz Band on the other.

Recorded at Earth Sound Studios at Brookvale the quality is really good. Overall, it adds up to a very enjoyable record, all the musicians having had wide experience both here and overseas.

The piano tracks are: Bearcat Crawl – Shoe-Shine Boy – The Pearls – Dusty Boogie – Red Pepper – Spicy Rag – The Naked Dance.

Nick Boston's offerings include: We Shall Not Be Moved – Savoy Blues – Mabel's Dream – Frog-I-More Rag – The Entertainer – Sentimental Journey – Snake Rag.

It is easy to appreciate the reason for these musicians' popularity when you hear a record like this. (N.J.M.)

★ ★ ★

THE TWO SIDES OF BARRY BAILEY: the Rodgers Marquee theatre organ. Festival 2-record set L-45607/8.

Perhaps it's ungracious to make comparisons but I must confess to some disappointment with this new Barry Bailey release, after having commended so highly Reubert Hayes' rollicking recital on a similar organ (November '75 issue). Whereas that one was made in an actual theatre, with all the atmosphere of a big organ in a big environment, the sound here is much more restricted, much more clinical; more a preoccupation with the Rodger's voices than a spontaneous performance. The effect is heightened, I think, by a recording situation which has given too much prominence to the middle register and a "boxy" kind of sound.

Tracks on the four sides include such numbers as: The Entertainer – More – Lara's Theme – Begin The Beguine – Jealousy – Hungarian Dance No 5 – Stephanie Gavotte – Roses Of Picardy – Colonel Bogey . . . etc.

For popular organ buffs it may have an interest in terms of the voices available but as a performance for straight listening, it didn't grab me. (W.N.W.)

★ ★ ★

THE HIT SOUNDS OF THE JAN DAVIS GUITAR. Jan Davis. Interfusion L25216. Festival Release.

Jan Davis is a self-taught and self-styled guitarist. Hits featured on this album are: Lady Marmalade – To The Door Of The Sun – Laughter In The Rain – My Boy – Have You Ever Been Mellow – Another Somebody Done Somebody Wrong Song. The remaining six tracks are original compositions.

At $3.99, this would be a reasonable buy if you appreciate hit songs played as guitar instrumentals. Be warned, however, that some tracks have excessive background hiss. (D.W.E.)

★ ★ ★

MUSIC FOR SKATERS. The Organ Masters. Stereo, RCA Camden cassette VCK1-7062.

The closest I ever came personally to rhythmic skating was as a teenager in the boisterous environment of a country roller rink. But, if I had ever graduated to ice and to terpsechorean activities

LIGHTER SIDE—continued

thereon, this is probably the kind of music to which I would have responded: strict tempo, not too fast, flowing, tuneful and familiar:

Quentin's Theme – The Alley Cat Song – Blue Danube – Barcarolle – Everybody Skate – Skater's Waltz – Love Me Tonight – Moments To Remember – Happy Heart – Waltz Of The Flowers.

They're played on organs—probably duo organs—recorded very cleanly but at the carefully regulated volume necessary for such an environment. The antithesis of modern pop, maybe, but I can well imagine it having a strong nostalgic appeal, whether or not you're an ice skating fan. (W.N.W.)

★ ★ ★

MILLION DOLLAR BILL. Billy Thorpe. Infinity L35767. Festival release.

Leaving his Aztecs behind, Billy Thorpe has embarked on a solo career. This album was recorded late in 1975 at the Sydney studios of Festival, and is technically quite good, with very little surface noise. Billy himself is quite subdued; he seems to have left his 5000 watts of Aztec energy behind him, along with the Aztecs!

Included along with the title track (an instrumental) are several self-penned numbers, as well as ones by Chris Jagger, and the Beatles (Drive My Car). There are no real surprises on this album, all of the tracks are of the high standard one would expect from Billy. One thing, however, did intrigue me. How did they produce the sound of a demented blow-fly in my speaker enclosures during one number? (D.W.E.)

★ ★ ★

WEBB BROTHERS. Live in New Zealand. Festival L35401.

The three Webb Brothers from Gympie in Queensland do a fine job of this seventeen strong collection of country style songs, with titles like: Tina – I'm Gonna Be A Country Boy Again – The Melody Of Rain – The Purple Petrol Eater – The Call Of The Bell Bird – Old Australian Home – It's Four In The Morning – Kiss An Angel Good Morning – Running Bear – Cotton Fields.

The live audience in Christchurch gave them a well deserved rousing reception. If you have anyone in mind that likes country music, this would be an ideal Christmas gift for them. The quality is good and the live audience is well carried on the disc. (N.J.M.)

★ ★ ★

VIVA CONGALONGAMAX, Max Bygraves Astor SPLP 1447

Max Bygraves is always easy to listen to and this sing-along collection in Latin American style is no exception.

With a medley of twenty-two titles, mainly with a Latin origin, it would be an ideal party starter. Some of the tracks are: Enjoy Yourself – The Coffee Song – Quando-Quando-Quando – Blue Skies – Am I Blue – Besame Mucho – Spanish

JUST WANNA ROCK'N'ROLL. Jose Feliciano. RCA Victor APL1-1005.

"I can only sing what I feel" says Jose. And although he has been blind since birth, he has certainly managed to express his feelings in a way which most people can understand. And not only can Jose sing, he is a superb guitarist as well.

On this album, he presents a variety of music, ranging from rock through to ballads. Tracks which appealed particularly to me were: Marie – Twilight Time – Thank God – Rock'n'roll.

Record quality is excellent, surface noise in particular being notable for its absence. (D.W.E.)

Eyes – Wedding Samba – The Laughing Samba – Yellow Bird – Island In The Sun – Jamaica Farewell. With an excellent vocal backing group and an orchestra led by Frank Barber, the whole record goes together beautifully. I think you'll enjoy it. (N.J.M.)

★ ★ ★

MINSTREL IN THE GALLERY. Jethro Tull. Chrysalis L 35521. Festival Release.

This is the ninth Jethro Tull album and, as in previous efforts, Ian Anderson is the mainstay. The album commences with the title track, which compares the life of a minstrel with that of a contemporary rock artist. The following tracks continue on in this vein.

The showpiece of the album is undoubtedly "Baker St. Muse", which almost completely fills the second side. In this track, Ian appears to be thinking aloud, continuing his earlier reflections on the life of a musician.

Summing up, I would say that this album will undoubtedly be enjoyed by Jethro Tull fans, but will probably not attract many new listeners. Record quality is excellent. (D.W.E.)

★ ★ ★

THE HIGH PRIEST OF COUNTRY MUSIC. Conway Twitty. MCA Records MAPS 8033. (Astor Release.)

Whether or not Conway Twitty deserves the title he has been given on this album must be a matter of personal opinion. Judging from the material included, however, I would be inclined to agree.

The ten songs presented here are all of such a high standard that it is difficult to single out any in particular. Of his own compositions, perhaps the best is "Don't Cry Joni", in which he is accompanied by Joni Twitty. Other tracks which appealed to me were Johnny Tillotson's "It Keeps Right On A-Hurtin' ", and Bob McDill's "Amanda".

Summing up, this is a record which was no chore to review. The quality of the recording is excellent, surface noise being extremely low. (D.W.E.)

★ ★ ★

PATRICK O'HAGAN SINGS. Mono, Harlequin (Festival) L-25219.

For those who remembered and appreciated Patrick O'Hagan's concert and radio tours of Australia and New Zealand, this $3.99 album should provide a pleasant reminder of his style and repertoire. The jacket notes tell of his early struggle for recognition in London, his association with Jack and Jean Mayo, Sonny Hughes and Ted Heath, and his Australian mentor and accompanist Hal Stead. Then followed his successes on U.S. and British television.

A generous program presents thirteen quite varied songs: Wonderful Secret Of Love – When I Have Sung My Song – Christopher Robin – Magic Moments – At The End Of The Day – When The Children Are Asleep – Funiculi Funicula – Handel's Largo – Passing By – When I Fall In Love – Angels Guard Thee – I Love Thee.

Recorded in mono, the sound quality is a little on the thin side but is clean enough and won't prevent you from enjoying a renewed acquaintance with this popular Irish tenor. (W.N.W.)

★ ★ ★

HELLO IT'S ME. Lani Hall. A&M stereo L 35427

Lani Hall's style, like many of today's so-called blues singers is deadly monotonous. In fact, just why this style of singing is popular (or so it seems) is beyond me. There is no doubt that Lani Hall has a fine voice but it won't be used to best effect until she changes her style to something brighter.

Recording quality is only fair but I suppose it's not a great deal worse than I have almost come to expect of that originating from the A&M studios.

Ten tracks are featured: Hello It's Me – Peace In The Valley – Time Will Tell – Banquet – Wheelers and Dealers – Happy Women – Exclusively For Me – Save The Sunlight – Sweet Jams And Jellies – Corrida De Jangada. (L.D.S.)

★ ★ ★

GIFTED & BLACK. Nina Simone. Contempo-raries VPL1-4015. RCA Release.

Nina Simone has been in the public lime-light since 1959, and has amassed a large number of fans in the years since then. Listening to this record it is easy to see why. A talented pianist, as well as a fine vocalist, she performs with a style that ranges through popular jazz and folk to gospel.

In order, the eight tracks included are: Black Is The Color – Since My Love Is Gone – Blue Prelude – Spring Is Here – Porgy – Remind Me – Near To You – The Thrill Is Gone. In the main, these are all slow ballads, and make very pleasant listening. The first song, written by Nina herself, is perhaps the best on the album, and appealed quite strongly to me.

Recording quality is good, with just the right balance between vocals and piano. The only minus point is that there is noticeable crackle on some tracks. (D.W.E.)

★ ★ ★

LEMMINGMANIA. Amon Duul II. United Artists L 35591. Festival Release.

Amon Duul II is a German rock band, previously unknown to me. A synthesiser is featured prominently on a number of tracks. Judging from this record Amon Duul II appear to have a style similar to that of Pink Floyd. Rather surprisingly, most of the lyrics are in English.

Although all the tracks are of a good standard, the following tracks particularly impressed me: Archangel's Thunderbird – Rattlesnakeplumcake – All The Years Round – Lemmingmania. The second-last track listed is distinguished by vocals supplied by the only female group member.

Recording quality is excellent, although some background noise is evident in the quieter sections. If you want to sample a track before you buy, try the first one on the first side. (D.W.E.)

CLIFF BINGHAM EXCELLS ON THOMAS CELEBRITY

THE SOUND OF EXPERIENCE. Cliff Bingham playing the Thomas Celebrity Royale 871. Stereo, Unison Productions ULP-050. (From local record stores ($4.99) or direct from Unison Productions–118 Terry St, Rozelle 2039, plus 60c P&P.)

If I seemed to be particularly enthusiastic about Reubert Hayes' "Favourites Of The Forces Singalong" in the November '75 issue, here's another one that I would commend to electronic organ enthusiasts. But whereas Reubert Hayes recreated the mood of the old cinema organ on the Rodgers electronic, this is a pure, undisguised electronic solo organ recital with a Leslie speaker, auto rhythm, a variety of voices and excellent piano stops. But the recital doesn't rest on effects and they are not over-used. What impresses above all is Cliff Bingham's immaculate phrasing, fingering and tempo aided, no doubt, by a most responsive instrument.

In a program of twelve numbers, he presents: Joy – Sunshine Of My Life – American Patrol – McGooley's Theme – Turkish Rondo – Dengoza – Mame – Get Happy – Sunny – Air On A G String – Old Piano Roll Blues – Clarinet Polka.

Another production by young Sydney engineer Malcolm Able, this recording of the young Sydney organist is as notable for its engineering as it is for its execution. Recommended for general listening but especially to popular organ enthusiasts. (W.N.W.)

New Products

Low-cost 3½-digit multimeter

The newest instrument in the Hewlett-Packard line is the Model 3476. This is a 3½-digit multimeter capable of measuring AC and DC voltages, currents and resistance to an accuracy of 1% or better. Main features include automatic polarity selection, automatic zero blanking, and automatic range selection.

The Hewlett-Packard Model 3476 is a compact five-function DMM offering full auto-ranging facilities at the relatively low cost of $210 plus sales tax. The unit employs the latest fine-line, tantalum nitride resistor technology, thus eliminating the use of more costly discrete precision resistors.

Built in logic provides the auto-ranging, auto-zero blanking and auto-polarity facilities. For those few occasions where noisy or spikey signals, such as are encountered in TV circuits, cause auto-ranging problems, an "auto hold" button has been provided. This feature also facilitates measurement of diode resistance and speeds up repetitive measurements of near constant inputs.

Measuring capabilities are as follows: DC volts from ±100uV to ±1000V; AC volts from 300mV to 700V RMS; DC current from 100uA to 1.1A; AC current from 300uA to 1.1A; and resistance from 1 ohm to 11 megohms.

Typical accuracy for DC voltage measurements is 0.5%. DC current accuracy is 1.0%. On AC voltage ranges, frequency is specified to 10kHz, while AC current measurement is to 5kHz. Accuracy of resistance measurements on the three highest ranges is to 0.6% and to 0.4% on the two lower ranges. Open circuit voltage is less than 4V.

Input resistance on all voltage ranges is 10 megohms, with input capacitance less than 30pF. The 3476 is protected to 1100V peak on all ranges. The fuse that protects the ohms function is rated 250V RMS. The current function is fuse protected to 1.5A. No special fuses are required and they can be quickly replaced without disassembling the instrument.

The LED readout is clear and unambiguous. It displays all voltage readings in volts, all resistance readings in ohms, and all current readings in amps.

Ruggedness is assured with the high impact-resistant polycarbonate case. A three-position bail gives the user flexibility in placing the 3476 for most convenient use.

Two versions of the HP 3476 3½-digit multimeter are available.

Model 3476A is AC line powered only; Model 3476B is also AC line powered and, in addition, includes rechargeable nickel cadmium batteries. Typical operating time on fully charged batteries is 8 hours.

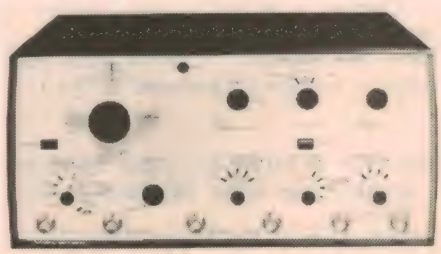
Both units measure 6.5cm high, 16.8cm wide and 20.6cm deep. Model 3476A weighs 0.71kg and Model 3476B weighs 0.91kg.

For further information contact Hewlett Packard Australia Pty Ltd, 31-41 Joseph St, Blackburn, Vic 3130. Branches in Adelaide, Brisbane, Canberra, Perth and Sydney. Also in Auckland and Wellington, New Zealand.

Crystal controlled function generators feature 0.01% accuracy

Wavetek has announced two new function generators with crystal controlled accuracy, XCG. This new feature gives the versatile function generator synthesizer accuracy. The output of Models 181 and 183 is accurate to better than 0.01% of setting at the XCG frequencies. There are 120 XCG frequencies for Model 181 and 150 for Model 183.

The Model 181 offers sine, square, triangle and DC outputs with frequencies from 0.1Hz to 2MHz and internal 1000:1 sweep. The two main outputs (high and low) are 30dB variable for waveforms: up to 20V p-p (10V p-p into 50 ohms) for



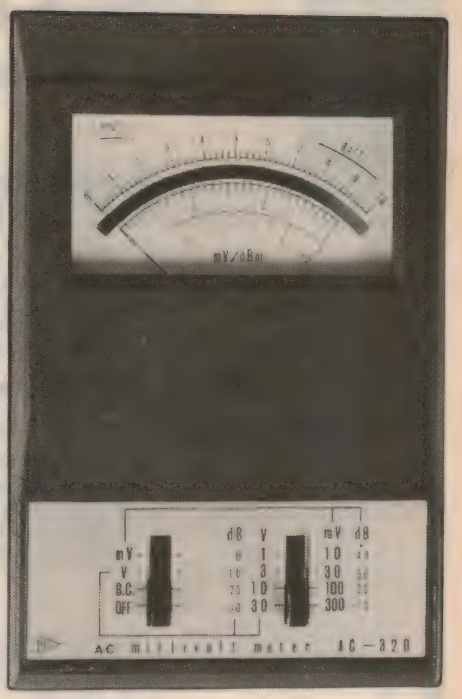
high and up to 1V p-p for low. The output waveform may be offset up to ±10V. (A DC-off position assures zero offset.) TTL pulse and voltage-proportional-to-frequency outputs are also provided.

The Model 183 offers the above features and even more versatility with 0.0001Hz to 5MHz and triggered and gated modes. There is also variable symmetry control for pulse and ramp waveforms. Calibrated start and stop controls give precise sweep range. Waveforms and DC from the single output have up to 60dB attenuation in 20dB steps. In addition, waveform amplitude is continuously variable to 20dB for a maximum of 80dB attenuation.

Local agents for Wavetek are Kenelec Systems Pty Ltd, 142 Highbury Rd, Burwood, Vic 3125.

Low cost audio millivoltmeter

This compact and low-cost audio millivoltmeter features an input impedance of 1 megohm on all ranges, a frequency response covering the full audio bandwidth, and a mirror-backed scale. AC voltages ranging from 200uV to 30V RMS can be measured.



The Belco AC-320 audio millivoltmeter is housed in a black plastic case, measuring 92 x 145 x 40mm. Two four-position slider switches are mounted below the meter movement. The left hand one has an OFF position, a BATTERY CHECK position, and two scale positions (V and mV). The right hand switch functions only as a range switch, and is used in conjunction with the left hand switch.

The meter movement appears to be a standard 100uA unit, and is mounted inside the case, with the scale showing through a rectangular cutout. A mirror-backed scale is fitted, with the two voltage ranges marked in black on either side. The dBm scale is marked in red, and being further from the mirror, cannot be read to as great an accuracy.

The eight voltage scales are 0-10mV, 0-30mV, 0-100mV, 0-300mV, 0-1V, 0-3V, 0-10V and 0-30V. Each voltage scale has corresponding graduations in dBm, with 0dBm corresponding to 0.775V. This is equivalent to 1mW into 600 ohms.

The quoted accuracy is plus or minus 3 per cent of full scale. Initially, we measured errors much greater than this. However, after following the calibration procedure given in the accompanying instruction manual, we were able to verify that the errors were less than 3 per cent. The movement did show some non-linearity, although this would only become important at the low end of the scale.

The calibration procedure requires an accurate 10mV or 1V RMS sinewave source, so if you do not have access to a suitable generator, it would be wise to have the calibration checked before purchase.

The input impedance on all ranges is 1 megohm. This is achieved by use of a FET in the source follower mode, eliminating loading effects on the input divider chain. The FET drives a second divider chain, the output of which goes to a 709 type IC operational amplifier connected as a precision full-wave rectifier.

The frequency response is claimed to extend from 20Hz to 100kHz, plus or minus 1dB, with 1kHz as the reference frequency. We found this to be correct for all ranges except the 1V range, where the response was down 2dB at 100kHz. On all other ranges, the response was 2dB down at 200kHz, and within 1dB at 100kHz.

Jitter of the indicating needle did not become appreciable till frequencies below 15Hz were measured, and a useful indication could be obtained at frequencies down to 10Hz. This means that the unit is quite suitable for use as an audio millivoltmeter, and would be a handy addition to a test bench.

Accessories supplied with the unit include a small but comprehensive instruction brochure and a 1-metre measuring lead fitted with colour coded crocodile clips. The lead connects into the meter via a standard 3.5mm earphone jack plug.

The meter is powered by a standard 9V miniature battery. Current consumption is approximately 5mA.

In use, we found the unit to be easy to use. It did not seem to suffer damage from the occasional overload that we inadvertently subjected it to, and appeared to be quite rugged.

The Belco AC-320 Millivoltmeter is available from Dick Smith Electronics, 162 Pacific Highway, Gore Hill, NSW 2065. The price is $36.00 including tax, or $33.60 tax free. Package and postage is $2.00. (D.W.E.)

Drake SSR-1 general coverage receiver

Elmeasco Instruments announce the availability of the new Drake general coverage shortwave receiver, type SSR-1. The new receiver offers features formerly only found in expensive commercial communication receivers.

The front end of the receiver uses a drift cancelling double frequency changer configuration, of the Wadley loop type. This gives 30 effective bands, each nominally 1MHz wide except for the lowest which covers 0.5-1MHz.

A 10MHz crystal is used for the source of 1MHz harmonics, being divided by 10. The first IF is 44.5-45.5MHz, the second 2-3MHz, and the third 455kHz. Two IF bandwidths are provided, and there is a product detector for CW/SSB as well as a diode detector for AM.

An RF preselector is fitted, to provide optimum sensitivity and signal handling performance. Sensitivity is better than 0.5uV for 10dB S+N/N ratio. Tuning dial accuracy is quoted as better than 5kHz.

Other features of the receiver include all solid state circuitry, a choice of inbuilt or external antennas, and operation from either the built-in battery supply or external DC or AC power sources.

Manufactured by the R. L. Drake Company of Miamisburg, Ohio, the SSR-1 receiver is available here from Elmeasco Instruments Pty Ltd, P.O. Box 334, Brookvale, NSW 2100, and also P.O. Box 107, Mount Waverley, Victoria 3149.

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101 1MHz Crystal Cal.
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103 V.H.F. Dip Osc.
104 V.H.F. Powermatch.
105 V.H.F. F/S Detector.
106 S.W.R. Reflectometer
107 R.F. Impedance Bridge.
108 Signal Injector
109 1972 FET Dipper.
110 Digital Freq Meter.
111 Simple Logic Probe.
112 Frequency Counter & DVM Adaptor.
113 Improved Logic Probe
114 Digital Logic Trainer.
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116 Digital Pulser Probe.
117 Antenna Noise Bridge.
118 Solid State Signal Tracer.
119 1973 Signal Injector.
120 Silicon Diode Sweep Gen.

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125 Model Control with Simulated Inertia.
126 Hi-Power unit 1968.
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129 SCR-PUT Unit with Simulated Inertia 1971.
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167 Fremodyne 4-1970. R.F. Section Only.
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169 160 Communications RX.
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Digital style read-out switches from Digitran

While, to many people, the name British Merchandising Pty Ltd is closely identified with QUAD amplifiers and loudspeakers, the Company does distribute a variety of other interesting products. Included among these, and well known to certain segments of the industry, is a whole range of read-out switches and resistance decades produced by the Digitran Company in Pasadena, California.

Series 24000 fast action, 10-position toggle switch.

From their inception, the electrical and electronics industries have used switches by the million, ranging from the simple and makeshift to complicated, highly sophisticated assemblies. Most of them, however, merely slide or rotate into a series of positions, which have to be identified by lettering on the associated panel.

The Digitran switches under consideration here are different; apart from their basic quality image, they carry their own digital style readout display. And, electrically, they can perform switching functions directly related to the needs of modern digital circuitry.

One of the simpler switches in the series is the series 29000 "Economy" miniswitch – a component that completely belies its catalog title.

It uses finger-actuated drum sections, self indexing and with the positions clearly displayed; drums are available for 10, 11 or 12 positions, while BCD and decimal versions are also available. The contacts and wiring centre around a miniature PC board, offering an initial contact resistance of 100 milliohms, an insulation resistance of 1000 megohms and a dielectric strength of 500 volts. Modules are available in black or ivory, which can be intermixed, if desired, to build up the desired number of switch functions. The assemblies are held together by an external stainless steel clip strap, and are normally styled for back-of-panel mounting.

In their publicity, Digitran point out that a single and very compact thumbwheel switch with three numeric drums and a + & - drum can replace on the panel a polarity switch and three rotary knobs, each with a large label.

The Digitran 28000 "Minilever" is described as "The switch designed for people who like to do a lot of switching". It is basically a drum system but a ratchet lever which is integral with each drum can rotate it to any desired indexing position for a 90-degree movement of the lever. An added feature is that the entire switch can be reset instantly to zeros by simply running a finger along it and pushing the levers to the full upward position.

British Merchandising keep BCD and decimal versions of the switch sections in stock but Digitran publicity mentions

Series 28000 "Minilever".

Series 29000 "Economy" microswitch.

8, 10, 12 position drums, while standard code outputs include: binary coded octal, single pole decimal, double pole decimal, complement of binary coded decimal, binary coded decimal, and BCD plus complement.

Components are of the highest quality throughout. Plastics are polycarbonate, nylon and teflon; MIL spec. PC board with gold on nickel; detent mechanism of beryllium copper heat treated, and hardware of corrosion resistant steel.

Another intriguing switch in the line is the Digitran series 24000 fast action 10-position toggle. Beneath the drum display window is a small toggle which can be operated up or down to rotate the drum in either direction. The action is very smooth and positive and the switch would seem to be ideal where a 10-position selector has to be mounted in a limited space, but nevertheless with good display and easy operation. Panel mounting is normally from the rear and internal lighting can be arranged. The mechanism has been designed to minimise the possibility of fouling.

A variant of this, which is not pictured, has a push-button to operate the drum instead of the toggle. The particular switch was developed especially for the aircraft and space industry where data has to be punched into navigational and other equipment by an operator wearing gloves—typically as part of a complete space suit.

Information and specifications for the Digitran switch range are available from British Merchandising Pty Ltd, 49 York St, Sydney 2000.

Electrodata recorders for Australian Navy

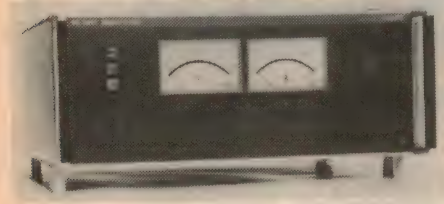
Electrodata Associates Pty Ltd, 18 Coward Street, Mascot, NSW, has received a contract to supply 14 special-purpose audio tape recorders to the Royal Australian Navy. The first prototype recorder (see photograph) has been designed, tested and delivered and is presently undergoing evaluation by the RAN.

The recorders are 4-channel, 4-speed machines designed to operate to the IEC audio standard at the lower 3 tape speeds and to the IRIG instrumentation standard at the top speed 30ips. Full input/output signal monitoring facilities are provided.

Electrodata Associates Pty Ltd is a company of magnetic recording engineers specializing in precision tape recording equipment.

NEW PRODUCTS

Electronic/magnetic AC voltage stabilisers



A series of electronic/magnetic AC voltage stabilisers providing a high 0.1% output stability has been introduced by Philips Scientific & Industrial Equipment. The PE 1610/11/12 series is designed to deal with worse case conditions covering input variations of between −15% and +10%.

These stabilisers are ideal for applications ranging from machine tool controls to computers. They are non frequency-dependent, and will handle inductive loads. Mains transient suppression of up to 60dB is possible, making the series ideal for working with TTL or CMOS circuitry where spikes on the line input have to be avoided.

Maximum output powers of 1, 2 and 4kVA are available. Output voltage is adjustable from 215V to 225V RMS. Distortion is less than 4%, and practically independent of mains distortion. The design is such that even a square wave input is converted to a sine wave output with very low distortion, less than 5%.

Built-in overload protection switches off the stabiliser if the output exceeds a (variable) preset limit, and there is overload protection through current limiting. Remote sensing is possible if the voltage drop in the current carrying leads is less than 1V.

For further information contact Philips Scientific and Industrial Division offices in each state.

Rocker DIP switches

The Grayhill 76 DIP miniature switch series has been extended by the addition of the recently released DIP-C range. The new range provides SPDT or Form "C" switching and is available in 2, 3 or 4-rocker packages.

Rocker actuators are located on 200 mil centres and terminal configuration is the standard DIP 0.1" x 0.3", making the switch fully IC socket compatible. Terminals are molded in to resist contact contamination during wave soldering and related cleaning processes, and optional protective covers are available.

Utilising Grayhill's proven spring-loaded sliding ball contact system, the DIP-C series feature wiping contacts, immunity to normal shock and vibration, and exceptionally long life. At logic loads, the switches are rated at 50,000 operations. Other ratings are 35,000 operations at 50mA and 30V DC and 25,000 operations at 125mA and 30V DC.

Enquiries to Acme Engineering Co Pty Ltd, Canterbury Rd, Kilsyth, Vic 3137.

High voltage test probe

Radio Parts has released the Rapar Model SK-9000 high voltage test probe, designed specifically for servicing colour TV receivers.

The Model SK-9000 is capable of measuring voltages up to 30,000V DC and current up to 600mA DC. Accuracy is specified at 3% of full scale at 20°C. Dimensions are 374 x 48 x 45mm and weight is 240 grams.

The probe has a safety guard ring, is compact and lightweight, and is easy to handle. A separate test lead is supplied for current measurements.

Enquiries to Radio Parts Group, 562 Spencer St, West Melbourne, Vic 3003.

22-contact DIP sockets

RN Robinson Nugent Inc, Indiana, USA, now has available a 22-contact DIP production socket. Designated part No. ICN-224-S4, the new socket offers reliable, low-cost mountings for 22-pin memories.

Main features include cross bars which may be snapped out after soldering for extra cooling or other component mounting, and 0.050 inch stand-offs to allow circuit repair and inspection without removing the socket. The socket body is of nylon rated to 150°C, and contacts are of phosphor bronze. Either gold over nickel or bright tin platings are available.

Contact General Electronic Services Pty Ltd, 99 Alexander St, Crows Nest, NSW.

Books & Literature

Primer on signals . . .

INTRODUCING ELECTRONIC SIGNALS By Ian R. Sinclair BSc MIEE, A.Inst. P. Published 1975 by Fountain Press, England. Stiff paper cover, 103pp 210mm x 135mm, illustrated by line drawings. Price in Australia $4.50.

In his preface, author Ian Sinclair suggests that his book is for the beginner, and that it aims to communicate broad principles of electronics, rather than the "nuts and bolts"—components and circuits.

He starts with signals and uses the familiar analogy of hydraulic systems for voltage and current but, within a few pages, he is talking about analog and digital signals, bandwidth, phase shift, gates and so on.

Following chapters cover: Inputs and Outputs; Radio Communication; Television; Radar; Digital Signals; Analog Signals. A general index brings up the rear.

Based on sample reading, I have no quarrel with Ian Sinclair's text but I do think that he is being optimistic in defining his book as one for beginners. I just don't think that the average beginner would be able to follow his giant leaps from one technical high point to another, even on a "concept" basis.

On the other hand it could be most helpful to those who have indeed familiarised themselves with the "nuts and bolts" of electronic circuits and who could more readily assimilate his ideas and concepts: how electronics is actually applied. In other words, I see it as a useful little book for the semi-initiated.

Our review copy came from Thomas C. Lothian Pty Ltd, 4-12 Tattersall's Lane, Melbourne 3000. (W.N.W.)

. . . and circuits

UNDERSTANDING ELECTRONIC CIRCUITS by Ian R. Sinclair, B.Sc, MIEE, A.Inst.P. Published 1973 by Fountain Press, England. Hard covers, 205pp 210 x 135mm, illustrated by circuits and diagrams. Price in Australia $10.50.

Ian Sinclair, formerly with the Research Dept of the English Electric Valve Co, and now at the Braintree College of Further Education, has designed this book to assist those who have some knowledge of electronics, but who wish to progress further. Dealing primarily with circuit principles, it is intended to form a companion volume to the same author's "Understanding Electronic Components".

Chapter headings give a good idea of the contents: Supplies & Bias; Amplification, Low Frequency Amplifiers; Tuned Amplifiers; Frequency Limitations In Untuned Amplifiers; Oscillators; Pulse Circuits; Logic And Counting Circuits; Power Supplies; The Oscilloscope; Index.

Ian Sinclair takes due note of valves, transistors and integrated circuits but, quite rightfully, tries to steer his readers toward a "black box" or module concept where the emphasis is shifted away from the individual active device to the basic function of the stage as a whole.

The text appears to be well written and sample reading turned up only one segment that could be misleading: page 29 on the subject of matching. Here the Author makes rather sweeping generalisations about matching source to amplifier and amplifier to load; however much the observations may apply in electrical theory, they certainly don't hold for matching audio power amplifiers to loads, or even RF power amplifiers into coaxial cables. Other vital considerations intervene.

But such reservations aside, "Understanding Electronic Circuits" could be helpful reading for those who want to expand their understanding beyond the basics of the subject.

Our copy came from Thomas C.. Lothian Pty Ltd, 4-12 Tattersall's Lane, Melbourne 3000. (W.N.W.)

Benchside data

MECHANICAL WORLD ELECTRICAL YEAR BOOK 1975/76. Published by Argus Books, England. Stiff paper covers, 383pp 154mm x 100mm. Price in Australia $7.50

According to the preface, the Electrical Year Book is in its 68th year of publication and one can only imagine how many of them, variously old and tattered, are near to the hand of electrical and electronic servicemen everywhere.

Logically, the book opens with a detailed index which should allow the user to find what he is looking for, provided he can come up with the right key word. For example, I picked out "Tape Recording standards" at one go but had to eliminate "pickups", "phono",

"gramo", "cartridge", etc, before arriving at "Record players".

In fact, electronic reference data from resistors and capacitors through to transistors and DIN standards occupy the first 60 pages. Then we strike alternating current and find ourselves in the world of the electrician—domestic and industrial. One gains the impression that, if one wants to know something, it will be there somewhere!

From about page 300 onwards the space is devoted mainly to units, charts and tables, even to a traditional set of mathematical tables—just so the reader won't have to go elsewhere for information!

At $7.50 it may not be exactly a cheap book but it would certainly be a handy one for the electrical and electronic tradesman. Our copy came from Thomas C. Lothian Pty Ltd, 4-12 Tattersall's Lane, Melbourne, 3000. (W.N.W.)

Transistor circuits

PRINCIPLES OF TRANSISTOR CIRCUITS, by S. W. Amos. Fifth Edition, 1975, published by the Butterworth Group (Newnes imprint), London. Limp or hard covers, 138 x 216mm, 320pp, many diagrams. Price in Australia $8.00 limp, $15.00 hardcovers.

This is the fifth edition of S. W. Amos' well-known introduction to circuit design using discrete semiconductor devices, the first edition of which was published in 1959. From memory it grew from a series of articles originally published in Wireless World. Author Amos was formerly head of BBC Technical Publications.

In producing the fifth edition the author notes that the text was updated by adding material on the use of FETs, and expanding the section on switching to become more of an introduction to digital circuitry in general. Apart from this, there have been virtually no changes.

As far as it goes, the book is still a well-written and very concise introduction to discrete circuit design. For those who are going to be involved in the development of this type of circuitry, it would thus make a valuable acquisition. There are chapters on basic device operation, amplifiers, bias and DC stabilisation, tuned amplifiers and oscillators, detectors and frequency changers, pulse and sawtooth generators and so on, and the text is well supplemented by diagrams.

My only reservation about the book at this stage is that it concentrates on an aspect of electronics technology which is fast becoming obsolete as far as most people are concerned. Before very long only a handful of designers in the labs of IC makers will be designing circuits in this way. More on designing with ICs would perhaps have been likely to be of greater long-term value.

The review copy came from Butterworths Pty Ltd, but stocks should be held by all major bookstores. (J.R.)

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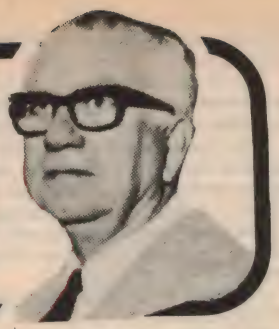
by Pierce Healy, VK2APQ



ITU—WARC draws closer

Amateur radio societies have about two years in which to complete their homework in preparation for the most far reaching radio conference in the past two decades.

The homework is to prepare and present a convincing set of proposals, acceptable to their administrative authorities, that will ensure that the interest of amateurs are favourably considered at the ITU World Administrative Radio Conference in Geneva in 1979. It is also encumberant on all amateurs to support their national society, to see that their suggestions are adequately considered, and that they are kept informed on progress being made on their behalf.

There have been many changes, both technical and international, since the 1959 WARC. For example, communication satellites are now a normal link in world communication systems. On the other hand there are now 44 more countries in the ITU than in 1959 (102 to 146); each concerned with its own internal requirements. It is probable that the number of national amateur radio societies have not increased since 1959. The only major expansion was the formation of the International Amateur Radio Union (IARU)—Region III Association, comprising national societies in Asia and Oceania.

It may not be realised that all ITU member countries, irrespective of size, population or wealth, have an equal vote. Only a minority accept the amateur service as one which should be fostered. Too often curtailment or suppression of amateur activity is the policy adopted.

The IARU does not have a vote. Its views can only be officially expressed through national delegations.

Fortunately there is opportunity for these negative views to be changed, or at least modified, if the pro-amateur countries produce convincing arguments, substantiated by facts, of the advantages amateur radio can and does provide to the community. But the real essence of success rests with good public relations by amateurs themselves, within their own local community and through national societies at government level.

Nor is this problem peculiar to amateur radio. Three very interesting papers were received early in December from Mr R. E. Butler, Deputy Secretary General of the ITU. Two were presented by him at the 12th General Assembly of the Asian Broadcasting Union, held in Adelaide, mid-November 1975. The third, an address given to the Rotary Club of Sydney at the begining of December, 1975.

Unfortunately space does not allow more than brief reference to some of the points they contain. One highlight is the thoroughness of planning necessary so that the most satisfactory agreements can be achieved at international level.

In the papers presented to the Asian Broadcasting Union an emphasis was given to the forthcoming WARC for the planning of the Broadcasting-satellite service in frequency bands 11.7-12.2GHz in Regions 2 and 3 and 11.7-12.5GHz in Region 1 to be held in January 1977.

It should be understood that no reference was made by Mr Butler to the amateur service; the 1977 convention is one of several ITU conventions held in relation to specific services. However, as the 1979 WARC will deal with all radio regulations and frequency allocations the following extracts could be taken out of their original context and, as guidlines, applied to amateur administration.

Members of the ABU were urged to do their homework in preparation for the forthcoming conference;

"I would now briefly like to draw your attention to the urgency concerning your preparation for the conference.

"The conference is scheduled to meet on 10th January, 1977 for a period of five weeks. We are now in November 1975 only 14 months away until the conference assembles.

"Naturally, much of the success of the conference will also depend upon the elaboration of an effective method of handling the complicated inter-relationships which exist between the relatory provisions applicable in the different ITU regions.

"The success of the 1977 broadcasting-satellite conference can only be assured of success if adequate preparations are undertaken by all concerned."

Too many of the current generation of amateurs and, in particular, those who hold office in the WIA, may not realise the real significance of an ITU—WARC. They may not know that, had it not been for the appreciation of amateurs in the 1959 era, of the threat that then existed to amateur frequency allocations, amateur radio would not be what they have known.

Recommended reading on the subject is "The Geneva Story 1959". Copies of which should be available from all WIA divisional libraries.

NZART GOLDEN JUBILEE

The New Zealand Association of Radio Transmitters Inc. will be celebrating its golden jubilee from Friday 4th June to Monday 7th June, 1976. The venue will be the North Shore Teachers' Training College, Auckland.

A wide range of activities has been planned for those attending. The conference will officially commence at 0915 hours Saturday 5th June in the main hall of the NSTC. At 1315 hours Dr William Pickering, Director of the Jet Propulsion Laboratories, USA, will give the keynote address. Dr Pickering was born and educated in New Zealand and was one of their early amateurs.

It is anticipated that there will be a number of overseas amateurs attending and arrangements are being made by a ladies' committee to make non-amateur visitors to the conference welcome. A tour to incorporate the convention is being organised from Los Angeles USA, and the Eastern and Mountain District Radio Club in Victoria is also organising a tour which, in addition to the convention, will include a sightseeing tour of Fiji.

Information regarding accommodation may be obtained from Ivor Williams, ZL1AGO, Accommodation Committee, Golden Jubilee Conference, PO Box 23-680, Papatoetoe East, Auckland, New Zealand.

NOVICE LICENCE

From statements which appeared in "WIANEWS" in the WIA publication "Amateur Radio" editorial for December 1975, it appears that there is considerable confusion regarding the sequence of events leading up to the novice licence recommendations which the WIA made to the PMG's Department.

The original report recommending a novice licence was presented a few days prior to the 1971 Federal Convention, and this report suggested a limited tenure of two years. Although a motion supporting the concept of a novice type licence was unanimously supported at this convention, approval of the actual report was deferred on the grounds that insufficient time had been allowed to study it.

Between this time and the 1972 Federal Convention, the Novice Licensing Investigation Committee circularised interested parties and, on the basis of opinions expressed, presented a modified report to the 1972 Federal Convention. Among the modifications was a recommendation of "unrestricted tenure". (Details of these recommendations appeared in these notes for March 1972.)

It was this report which, to quote from the "WIANEWS" editorial, "... crystallised thinking in relation to novice licensing". The situation therefore appears to be that, although the report which was adopted by the 1972 Convention recommended unrestricted tenure, this recommendation apparently was not contained in the recommendation subsequently submitted to the PMG's Department.

Indeed, it would appear that the quotation in "WIANEWS" given as the Novice Licensing Committee's Report is, in fact, taken from the deferred 1971 report and not from the 1972 report, which was accepted by the 1972 Convention. In this sense it would appear to be a mis-quotation.

UHF DX CONTACT

On Sunday, 22nd November, 1975 successful micro-wave contact was made between Mount Genini near Canberra and Mount Canobalis near Orange NSW. The test was carried out by Des Clift, VK2AHC/P/VK1 and Bill Cox, VK2ZAC/P. The distance was about 244km, the frequency 2304MHz, and signals were excellent both ways.

Accompanying Des at Mount Genini was Neil Sandford, VK1ZT, Dave White and Mike Rogers. Dave Ralph, VK2SB/P teamed with Bill at Mount Canobalis.

Des supplied these details of the equipment he used at Mount Genini. The 2304MHz gear was all solid state and powered by a 12 volt car battery.

The receiver local oscillator starts off at 63.166MHz which is transistor multiplied to 252.66MHz and then passes into a varactor multiplying nine times. Then into a high Q filter made from parts from an APX6 and operating at 2274MHz. This feeds a strip line balanced mixer (ex QST design) on which is directly mounted a MPF121 FET 30MHz preamp. The IF is an EC10.

The transmitter is a 19.2MHz FM crystal controlled oscillator multiplied to 460MHz with a power output of 12 watts and then into a varacter multiplying five times from which a filtered 700mW is obtained at 2304MHz.

The antenna is a 1.2 metre dish (not a true parabola) with a galvanised pipe wave guide to a coaxial transformer. Signals were unbelievably good as no great effort was made to optimise the position of the dish feed or the direction. It was so windy that the dish antenna had to be tied down to a fence.

Initial contact was made on 144MHz using a 1 watt transmitter and a five element Yagi from which a maximum signal report was received.

Also on hand was 6cm and 3cm equipment but unfortunately signals on those bands were not heard

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown 2200.

at either location. The result was not unexpected on the 3cm band but contact was considered a possibility on 6cm, although the path was not line of sight.

Future plans are to try 3300MHz over the same path and to investigate super refraction over water paths on 3cm along the coast.

AWARDS & CONTESTS

Throughout the world there are in excess of 6000 awards available to amateurs. The majority are for making a specified number of two-way contacts within stated areas. Others relate to working as many stations as possible within a set period of time.

The aspect of technical expertise is not so well catered for, although "member-built-it" contests are often conducted at radio club level. In the main this facet is acknowledged by the publication of technical articles in amateur magazines. But only a very small percentage of amateurs interested in design, construction, and experimentation write of their achievements.

One of the more recent international awards was the six band award, authorised by the IARU, for contacts after 1st January, 1974. The award required two-way contacts to be made with all continents on six amateur bands. The award is known as 6BWAC and the bands were 160, 80, 40, 20, 15 and 10 metres.

The first 6BWAC was won by Tokuro Matsumoto, JA7AO who finally achieved that goal on 2nd October, 1975.

There are two international organisations which cater for those interested in gaining various awards:

The International Certificate Hunters Club. The Australian representative is Alex Slight, VK2ZA, 31 Lamrock Avenue, Bondi Beach, NSW 2026.

The Award Hunters Club International. The representative in Australia is Allan Shawsmith, VK4SS, 35 Whynot Street, West End, Queensland 4101.

Both clubs have a minimum requirement for membership. Details may be obtained by writing to the above, enclosing a self-addressed stamped envelope.

Two of the most popular and sought after local awards are the New Zealand Counties Award and the Australian Commonwealth Electorates Award.

Most national amateur societies sponsor awards, as do a number of radio clubs. Awards sponsored by the WIA include:—"Australian DX Century Club Award"; "Australian VHF Century Club Award"; "Worked All States VHF Award"; "Worked All VK Call Areas Award"; "Worked All Call Areas (VHF) Award".

Organised jointly by the WIA and NZART is the "VK-ZL-Oceania DX Contest".

The biggest and most popular world wide event in the calendar of contests is the "CQ World Wide DX Contest".

Radio club awards: "The Southern Cross Award" sponsored by the Eastern and Mountain District Radio Club. The "Gold Coast Award" from the Gold Coast Amateur Radio Club; "City of Maitland Award" sponsored by the Maitland Radio Club; "The Hunter Branch Award" issued by the Hunter Branch of the NSW Division WIA.

The requirements to gain this award are as follows:—

(a) DX stations must QSO five different Hunter Valley amateur stations during any consecutive 12 month period.

(b) Australian amateurs (except VK1 and VK2) must QSO ten different Hunter Valley amateur stations during any consecutive 12 month period.

(c) VK1 and VK2 amateurs must QSO 20 different Hunter Valley stations during any consecutive 12 month period.

(d) SWL's must submit proof of having heard four different amateur stations from each of the six continents during any consecutive 12 month period.

All applicants for this award must submit the following information:—

(a) An extract from their log with a declaration that QSL cards have been forwarded.

(b) Hunter Valley amateurs must produce QSL cards.

(c) Forward applications to the Awards Committee, Hunter Branch, WIA, Box 134, PO Charlestown, NSW 2290, Australia.

Here are the rules for the "Zone 22 Award":—

1. This award is issued by the Radio Society of Sri-Lanka to all amateurs for having had two way radio communication with seven of the eight countries in Zone 22 for a total of 100 points made up as follows:—

9N1	Nepal	5 points
AC3	Sikkim	5 points
A51	Buthan	5 points
8Q6	Maldive Islands	5 points
VU	Laccadive Islands	5 points
S21	Bangladesh or	
AP	East Pakistan	3 points
4S7	Sri-Lanka (Ceylon)	3 points
VU2	India	2 points

Note: VS9 Gan Island (Maldive Group) is in Zone 29.

2. Only one contact with any one station, using any mode, any band, will count.

3. QSL cards must be held by the applicant for the contacts claimed.

4. Applications should list all available data and is acceptable if certified by the secretary of any national society or signed by two licensed radio amateurs.

Cards should be sent if called for. If cards are submitted sufficient postage must be included for their return.

5. Applications together with seven international reply coupons should be sent to:—

The Awards Manager, Radio Society of Sri-Lanka, Box 907, Colombo, Sri-Lanka (Ceylon).

RADIO CLUB NEWS

QWCA—SYDNEY CHAPTER: The Sydney Chapter—Quarter Century Wireless Association held its Christmas dinner party at the Elizabeth Room, RSL ANZAC Memorial Club, Cammeray, on Tuesday evening 9th December, 1975.

Thirty-nine persons consisting of members, their wives and friends were present. Eleven apologies for not being able to attend were received.

The evening commenced with pre-dinner drinks, followed by a very enjoyable dinner. President Harry Caldecott, VK2DA, welcomed all present and introduced Bill McGowan, VK2MQ as master of ceremonies for the evening, who called upon Wal Webster to say grace.

Toasts during the evening were, the Loyal Toast proposed by Peter Naish, VK2BPN; The QCWA—Eric Bierre, VK2BEK; The ladies—Bill Dukes, VK2WD.

Secretary Pierce Healy, VK2APQ passed to the gathering the personal best wishes of Richard Butler, Deputy Secretary General, ITU. This message was received with deep appreciation and a toast was spontaneously proposed to the ITU, its officers and its work.

Messages of greetings and good wishes were received from; Stan Belliveau, W7AYO on behalf of QCWA headquarters. Eric Roberts, K4RF of the new Palmetto State Chapter in South Carolina, and Bert Hay, G2KG ex-VK2AGW.

The evening concluded with a short address by president Harry Caldecott who expressed appreciation, both individually and collectively, to those who had helped to make 1975 a successful year for the Sydney Chapter—QCWA.

CENTRAL COAST AMATEUR RADIO CLUB: A final reminder that the CCARC Annual Field Day will be held at the Gosford Showground on Sunday, 22nd February, 1976. Program details were given in these notes last month.

This is the 19th year this event has been held, which caters for the whole family. Why not make it a weekend on the beautiful Central Coast? However, book early for motel accommodation as the field day coincides with the annual Festival of the Waters.

EASTERN & MOUNTAIN DISTRICT RADIO CLUB: The EMDRC is arranging a tour in June 1976. This is to include the New Zealand Association of Radio Transmitters Golden Jubilee Conference in Auckland and a sightseeing tour of Fiji. The tour is open to members, friends or relatives. If interested contact The Secretary, EMDRC, PO Box 87, Mitcham, Victoria 3132.

Although the date mentioned for applications has passed there may be some vacancies, or unforeseen cancellations.

Notice was given in the December, 1975 issue of "The Radio Bulletin", the journal of the EMDRC, of an extraordinary general meeting on Friday 27th February, 1976. The purpose is the proposal to repeal the current constitution and to adopt the constitution and standing orders as circulated in the December issue of the journal.

The venue will be the Coffee Shop, Nunawading Civic Centre.

GEELONG AMATEUR RADIO & TV CLUB: After hibernating for the last couple of years, members of the GARC will be participating in the John Moyle Memorial National Field Day to be held over the second weekend in February, 1976.

Considerable enthusiasm is being generated and with top class operators using top class equipment they hope to regain the club's former status in this annual event. Tentatively, the location for portable operation is Mount Cowley.

An item in the December, 1975 GARC newsletter reports that pigeon fanciers are erecting their club rooms adjacent to the GARC. It seems to be a case of an old and a modern method of communication getting together.

MOORABBIN & DISTRICT RADIO CLUB: At the annual general meeting of the MDRC the following office bearers were elected:
President—John Emery, VK3YVD; Vice-president—Roger Thomas, VK3YGP; Secretary—Graham Mason, VK3YCM; Treasurer—Bruce Wodetzki, VK3ZKR; Committee—Harold Hepburn, VK3AFQ; John Kerr, VK3BAF; Basil Carlyle, VK3AUN.

The retiring president, David Rosenfield, VK3ADM, who did not stand for re-election, completed his 7th year on the committee. In his report he recalled that the club membership had increased to 88 and financially the club's position was sound.

ILLAWARRA AMATEUR RADIO SOCIETY: At the November 1975 meeting of the IARS Jim Potts, VK2BBG was appointed as Illawarra WICEN co-ordinator. Visitors to the meeting were Ross Sampson, divisional controller and Rick Fletcher, deputy controller and communications officer of the State Emergency Services. Fruitful discussions were held with the view to cooperation between WICEN—IARS and the SES.

In his notes on moonbounce activity Lyle Patison, VK2ALU reports that a new 432MHz preamplifier was made and installed in the feed box during the month. Noise figure tests indicated a 0.3dB lower figure than the original preamplifier.

The second moonbounce test with WA6LET resulted in contact for the first time on 22nd November, 1975. The signal report received was R5-S5-T9. WA6LET was received at 18dB above noise on peaks. An input isolating relay then developed high contact resistance and terminated that test.

The following week on the 29th November, 1975 further scheduled tests were carried out. The stations concerned were ZE5JJ, who later reported that heavy rain prevented operation, and SM5LE who was not heard. However, JA1VDV was heard at 8dB above the noise. VK2AMW's own echoes were the loudest ever at one time; 12dB above noise.

Lyle expressed his thanks to Peter Fackender, who made and installed the much needed 15MHz dipole for use in liaison contacts.

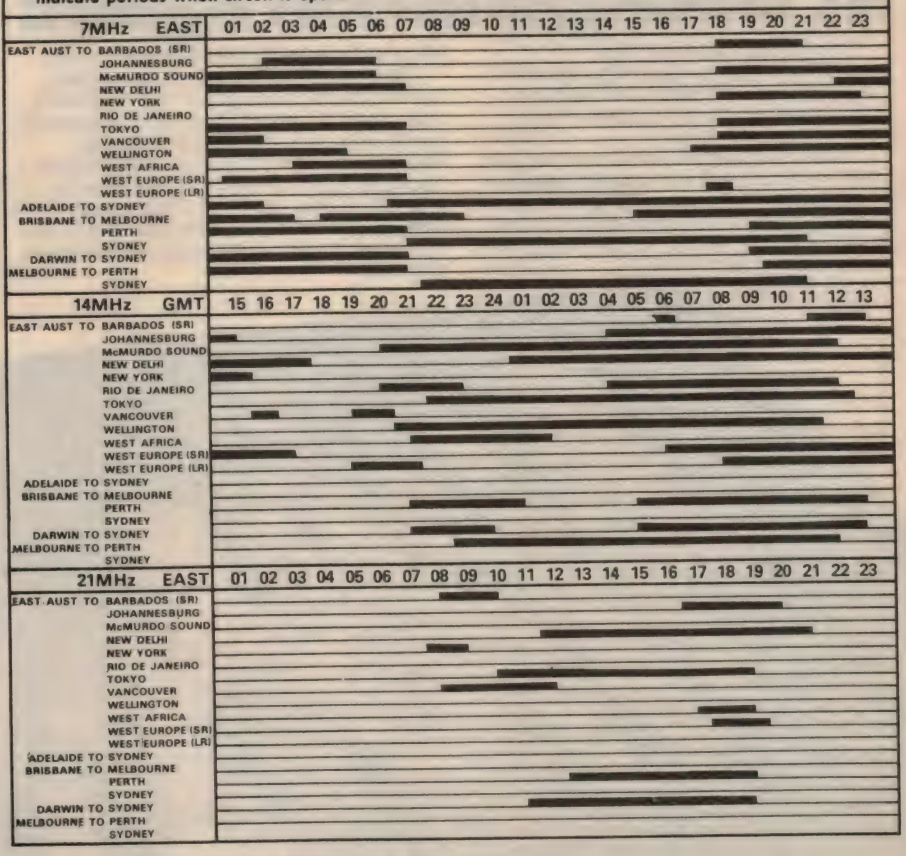
CAIRNS AMATEUR RADIO CLUB: There are now 27 active licensed operators in the Cairns area. It has been suggested that from the high recruitment in the signals branch of the State Emergency Service there may be some persons interested in studying to become licensed operators. With this in mind the CARC will commence classes for those interested in obtaining an amateur license.

WIA YOUTH RADIO SCHEME

On Tuesday evening, 2nd December 1975, the IREE Efficiency Pennants, awarded for the 1974 efforts of YRS registered clubs in NSW, were presented by Mr R. Lackie, president of the IREE, at an IREE meeting at the Sydney University's Department of Electrical Engineering.

IONOSPHERIC PREDICTIONS FOR FEBRUARY

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 2.76



The pennant for the top-marking non-school club was awarded to St George YRCS Training Annexe, where Noel Ericsson, VK2MF has provided training up to AOCP level for a number of years. Noel accepted the pennant and was later entertained by his club members.

The most efficient school club was Parramatta Marist Brothers High School. In the absence of Brother Cyril Quinlan, VK2ACQ who is overseas, the pennant was accepted on his behalf by Rex Black, VK2YA YRCS NSW state supervisor.

At the Katoomba High School on 2nd December, 1975 the top student in the fifth form electronics course, Stephen Tonner, received a book prize from the Blue Mountains Branch, WIA and a parcel of radio parts from the YRS.

Stephen is the first high school student to have completed an electronics course approved by the Board of Secondary School Studies and registered with the YRS committee.

It is reported that the NSW Sport and Recreation Service will issue certificates of training for the UNSWARS vacation course students who complete a trial novice examination.

At the end of 1975, there were 23 clubs registered with the Youth Radio Scheme in New South Wales:

Crestwood Radio Club, Baulkham Hills.
St. George YRCS Training Annexe, Brighton le Sands.
Camtec Radio Group, Mount Victoria.
Westlakes Radio Club, Teralba.
Armidale Police Boys' Club, Armidale.
Whalan High School Radio Club, Blacktown.
Swansea High School Radio Club, Swansea.
Normanhurst Radio & Electronics Radio Club, Normanhurst.
Katoomba High School Electronics Course, Katoomba.
Cessnock High School Electronics Course, Cessnock.
Kogarah Martist High School, Kogarah.
Marsden High School, Blacktown.
University of NSW Amateur Radio Society, Kensington.
Penrith High School Radio Club, Penrith.
Cowra High School Radio Club, Cowra.
Springwood High School Radio Club, Springwood.
Newcastle Boys High School Radio Club, Newcastle.
Kiama High School Radio Club, Kiama.
Parramatta Marist High School, Parramatta.
St Edmonds School for Blind Boys, Wahroonga.
Springwood Vacation Course, C/- NSW Sports & Recreation Service Parramatta.
Toronto High School, North Ryde Church of England Boys' Society Club.
Richmond River High School.

Hey Mum, I beat Dad at Backgammon again!

When mum sent away for a backgammon set for the family, she didn't really understand how a 1,000 year old game could suddenly have become so popular. Now she knows.

Young Michael has been practising all weekend and poor Dad has only played a game or two. Michael's beating the pants off Dad tonight, but Dad plans to get in a few games practise during his lunch hours this week. It's here, backgammon, the age old game of kings and gentry and sweeping the world.

Now you can join in the fun by sending for this special reader offer. You'll receive a finely crafted backgammon set in a special handy attractive attache carrying case **PLUS** a hard cover fully illustrated book on backgammon — everything you need for only $22.50 incl. postage. That's a real **special offer** when you consider sets of this quality often sell for up to two or three times this price.

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Fun for everyone If you can roll a dice and count to 6 you'll be playing backgammon from the moment you receive your set. And while it is a simple game, fortunes have been won and lost at backgammon throughout the centuries. You'll have fun playing everywhere, at home, at parties, barbeques, on rainy weekends, anytime. The more you play the more enthralled you'll become. Backgammon makes an ideal gift too.

Send for your set today Receive backgammon set and book for only $22.50. Backgammon sets of this quality could sell over the counter for up to two or three times this price. The set is designed into an attractive attache-style case, finished in quality tan vinyl leatherette. The playing surface is inlaid veneer timber. You also receive 2 sets of dice, 2 felt-lined dice tumblers, 30 playing pieces and a "doubles" counter.

The book "Backgammon", by Walter Gibson is included in the price. A fully illustrated beautifully bound, hard cover book, gives you a step by step quide to playing backgammon. If you're not completely happy with our offer, we will refund your money in full without hesitation. Fill out and mail the coupon today.

How to order: Fill in BOTH sections of the coupon. In each section print your full name and full postal address in block letters. Cut the entire coupon out around the dotted line. Send it with your money order or crossed cheque to **ELECTRONICS AUST.** Reader Service (Backgammon Offer) P.O. Box 93, Beaconsfield, N.S.W. 2014. Cheques should be endorsed on the back with sender's name and address and made payable to **ELECT. AUST.** This offer is open to readers in Australia only.

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Shortwave Scene

by Arthur Cushen, MBE

The recent Geneva conference on frequency allocations has completed its deliberations on the medium-wave frequency range, and major adjustments to frequencies are to be made. Short-wave allocations are expected to be liberalised.

Medium-wave frequencies have been allocated in the European, African, Asian and Pacific areas according to a new system. Stations are to operate on a 9kHz frequency separation instead of 10kHz as used in some of these areas at present.

In the past, Europe has operated on a frequency spacing of 9kHz. However, changes will still take place. The old band from 520-1602kHz has been replaced by a coverage of 531 to 1602kHz, and the 9kHz separations are numbered into 120 channels, replacing the existing 106 at present used in this area. This will mean more stations can be accommodated on the medium-wave band. There has been a reduction in the suggested number of stations from 10,000 to 7,000, and all stations will use directional aerials. One suggestion not agreed to was a power limitation to 300kW, so stations with super power of 2,000kW and higher will be still in operation.

The channels commence with Channel 1 on 531kHz, Channel 2 540kHz, and so on to channel 120 on 1602kHz. The major frequency shift, which will affect some 290 stations in Australia and New Zealand is scheduled to take place in 1978.

The conference allocated only two frequencies for low powered transmitters in Europe instead of the existing three. And in some cases, frequencies allocated to countries were more than required for existing stations, so that some free channels are available.

On the other hand, major attempts at synchronization of the same network program from several transmitters using the same frequency is expected to reduce the number of frequencies in use by some countries.

MUSCAT'S NEW VOICE

Some weeks ago test transmissions from Muscat were observed on several frequencies. Our reception of this new country was on 11890kHz at 2000GMT. Before this time there was interference from Radio Free Europe. Reception has also been reported of a broadcast 0300-0600GMT on 11890kHz and this included a news bulletin in Arabic at 0500GMT. During the test transmissions, English and Arabic announcements were given and reception reports were requested to the Technical Director, Ministry of Information and Culture, PO Box 600, Muscat, Oman.

UGANDA'S EXTERNAL SERVICE

Radio Uganda at Kampala has been heard in several new transmissions by listeners in this area. A broadcast to North Africa on 9730kHz is on the air 1930-2100GMT, and this includes a program in French at 1930GMT, Arabic at 2000GMT and English at 2030GMT. There is considerable interference on this channel from Radio Berlin International, while Radio Australia has also used the frequency.

A report in Sweden Calling Dxers outlined other transmissions from the Uganda Broadcasting Corporation. These include: 1400-1600GMT on 6030kHz with English 1530-1600GMT to East Africa; 1615-1730GMT on 9515kHz to South Africa in English; and Tuesday, Thursday, Saturday and Sunday on 15325kHz at 1800-1830GMT in English to West Africa.

The test transmissions have also been heard in Australia and Robert Hanner of Melbourne reports reception on 9730kHz with an English announcement at 2100GMT. Reports were requested to the Overseas Service of the Uganda Broadcasting Corporation, PO Box 2038, Kampala, Uganda.

CHANGES TO DX JUKEBOX

The popular DX Jukebox program broadcast over Radio Nederland now has a new Asian reporter. In the past the program has been supplied by Greg Calkin from Pakistan, but he has now returned to Canada. The new reporter is Victor Goonetilleke, Galle Walauwa, Piliyandala, Sri Lanka, who is heard on the fourth Thursday of the month.

DX Jukebox is now compered by Dick Speekman. The Pacific DX Report is supplied by Arthur Cushen on the first Thursday of each month, the North American report by Glen Hauser on the second Thursday and the Scandinavian report by Jan Tuner on the third Thursday. The transmissions are received via Bonaire at 0645GMT on 11730kHz and at 0815GMT on 9715kHz.

ENGLISH FROM MOSCOW

The special transmission from Radio Moscow for Australia and New Zealand has recently been retimed and is now broadcast 0800-1000GMT. The broadcast is carried on 9780, 11690 and 15150kHz. Recently, the additional frequency of 15380kHz was added for the transmission and on March 7 another channel, 17870kHz, will be brought into this service to the Pacific area.

KGEI'S NEW SCHEDULE

The tentative schedule for KGEI in San Francisco shows that from March 7 there is to be a reduction in the use of their 250kW transmitter. The new schedule is 2330-0200GMT on 15355kHz, and 0900-1400GMT on 5980kHz. The 50kW transmitter is used 2130-0200GMT on 15280kHz, 0200-0700GMT on 9615kHz, 0700-0900GMT on 5980kHz, and 0900-1500GMT on 9615kHz. The English broadcasts are: 0630-0700GMT on 9615kHz, 0700-0800GMT on 5980kHz, 1000-1100GMT on 5980kHz. The last two English transmissions are beamed to the Far East. The address of KGEI is, the Far East Broadcasting Company, Box 15, San Francisco, California 94101, USA.

FREQUENCY CHANGES

The External Division of Radio New Zealand has recently introduced 15130kHz in place of 15110kHz for the transmission to the Pacific Islands. This broadcast is heard 2130-0445GMT up to March 7, and after that date an hour later.

Radio Australia has introduced the new frequency of 9515kHz in place of 9530kHz for the broadcast 2100-2400GMT. According to Mark Shiell of Adelaide, a further change is the replacement of 11930kHz with 11940kHz for the broadcast 2100-2300GMT. The new transmitter at Carnarvon made its initial tests according to the following schedule: 0800-1030GMT in Indonesian on 9540kHz; 1030-1300GMT in Mandarin on 9560kHz and 1300-1430GMT in Cantonese on 9560kHz. All three transmissions were carried on a 250kW transmitter. A second transmitter of 100kW is expected to come into operation this month.

MEDIUM-WAVE NEWS

TAVALU: The Ellice Islands, previously a part of the Gilbert and Ellice Islands colony, have formed a separate colony under the name of Tavalu as from January 1, 1976. A station at Funafuti, operating on 580kHz, has been heard in New Zealand around 0800GMT with typical Island music. The Gilbert Islands continues to be received with broadcasts from Tarawa on 844kHz.

JORDON: According to the BBC Monitoring service, the high-powered Jordon station on 912kHz is located at Ajlun. This station was heard with a test period, and is now in regular operation using the power of 1200kW.

NEW ZEALAND: Radio Rhema is operating on an experimental basis broadcasting special one day Gospel programs with one transmission from Christchurch and another from Wellington. The last broadcast from Wellington was on 890kHz and, according to the verification, the power is 100W. The station hopes to obtain a full-time licence.

LISTENING BRIEFS

EUROPE

RUMANIA: Bucharest has been heard with an English broadcast to the Pacific 0645-0715GMT on the new frequency of 17790kHz. The reception is clear, but signals are better received on 11940kHz which carries the same program. Other frequencies used are 15240 and 15380kHz. The new frequency of 17790kHz suffers some sideband interference from Oslo, Norway, on 17795kHz which opens at 0700GMT.

FRANCE: Radio France has expanded the use of transmitters carrying some of its programs, and we note that at 0600GMT Paris is broadcasting in French on 13 frequencies. Our reception has been best on 6045, 7130, 9605, 11700 and 11735kHz. Other frequencies in use include 5990, 9700, 11960, and 17800kHz which also give fair reception.

HUNGARY: Radio Budapest has a service to the Pacific in English and reception at 1030GMT is best on 17865kHz. Other frequencies in use are 11910 and 15160kHz.

ITALY: Rome Radio is broadcasting to Australia in Italian from 0830GMT on 21690kHz. Reception in New Zealand has been good during the summer.

ASIA

SOUTH VIETNAM: The Saigon Station is now operating as "Liberation Radio", and according to a listener in Japan is broadcasting 0800-1600GMT and 2200-0100GMT. Three frequencies are used: 6165, 7245 and 9620kHz.

KUWAIT: Radio Kuwait is now scheduled to broadcast in English 0800-1100GMT on 15345kHz and 2000-2300GMT on 955 and 11940kHz.

INDIA: The General Overseas Service of All India Radio to Europe will remain on the following schedule: 1745-2230GMT on 7224, 9525 and 11620kHz; and from 1945GMT also on 9912kHz and 11740kHz. The latter two frequencies give good reception in Australia and New Zealand.

AMERICAS

CHILE: Two signals from Santiago have been heard carrying news bulletins relayed from La Voz de Chile. Jack Buckley of Sydney has been hearing Radio Yungay on 9650kHz, with news at 1100GMT. Our reception on 9750kHz at 1000GMT has shown that Radio Mineria also carries news in Spanish at this time from the same network.

MEXICO: Radio Mexico has been heard on 15385kHz with a good signal until closing at 0340GMT. The station is also operating on 9705 and 5985kHz. The full schedule is 1325-1530 and 2325-0340GMT. These broadcasts are in the external service of Radio Mexico and station details when closing are given in Spanish.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT, add 9 hours for West Aust. Summer time, 11 hours for East Aust. Summer time and 13 hours for NZ Summer time.

ANNOUNCING OUR NEW QUEENSLAND AGENT:
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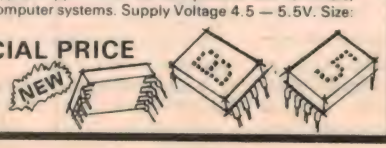

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INFORMATION CENTRE

CDI: Firstly I would like to say that you produce an excellent magazine catering for all tastes. This letter is in regard to the upgraded capacitor discharge ignition system in July's issue. (3/TI/12). I have built two of these units and found that it suffers from two faults. Due to the heavy current passing through the copper track it tends to act like a fuse and blows. The more important fault is that the converter as specified tends to oscillate not at 3kHz but more like 1MHz. I have found that a 0.1uF disc ceramic in series with a 10 ohm resistor across the whole primary winding has the effect of causing more reliable oscillation and also reduces the spikes on the leading edge of the square wave.

This fault could be my fault in that, instead of the transistors specified, being a negative earth car, I opted for PNP transistors, in the first case AY9149 and in the second MJ2955. Therefore this fault could be due to slightly different characteristics to the 2N3055. Just the same I thought it might be wise to let people know, in case they had the same idea to use PNP's. (G.B., Avondale Heights, Victoria.)

• Your admission is probably right. The AY9149 and MJ2955 have a very much higher gain-bandwidth product than the 2N3055 and hence they would tend to oscillate at much higher frequencies. The need to load the primary with such a low impedance RC network probably also explains why the converter draws heavy currents and "blows" the copper track. Other readers please note; neither problem has been encountered with the design as published.

GRAVITY WAVES: Congratulations on a great article in the October issue—"The Detection of Gravity Waves." Very interesting indeed and slightly off-beat for an electronics and hi-fi magazine. Could we please have more now that you have whetted our appetites?

One question though. In the illustration of the British X-ray telescope the caption states "... to observe the star Cygnus, believed to be a typical black hole." How can it be known if the star exists when it is stated in the text that "not even light can escape from the object"? If one can't observe the light is it still a star?—my definition of a star stems back to the rhyme "twinkle, twinkle . . ." (C. McC., Blacktown, NSW.)

• We are gratified to learn that you found the article on gravity wave detection so interesting. We will see what we can do about similar articles in the future.

The star Cygnus is known to exist because of the X-ray radiation it emits. This radiation is consistent with current black hole theory, and makes Cygnus a very good black hole candidate.

We feel that an astronomer's definition of a star may differ somewhat from that given in the familiar nursery rhyme!

TV PING-PONG: On seeing TV ping-pong (ie, table tennis on a TV screen) I was quite impressed, and thought that it would not be too expensive to build a unit for connection to a domestic TV receiver. As a regular reader of "Electronics Australia," I would like to suggest it as a project. I am sure that it will interest other readers, as well as being a switch from amplifier and hi-fi projects. (J.T., Adelaide, S.A.)

• A kit of parts for such a TV game is currently available and, as a start, we have assembled one. Our reactions are given earlier in this issue.

PAL-P RECEIVERS: Do you know if any manufacturer anywhere in the world is producing PAL-P (chroma-lock) colour TV sets? If not, why has the system not been used? (C.K., Malvern, Vic.)

• As far as we know no such sets are being produced. Out latest authority for this is Dr Bruch, inventor of the PAL system, to whom we put the same question when he visited Australia for the IREE convention in August. The reason is not clear, except that it offers only a marginal (almost academic) advantage over PAL-D and would probably cost at least as much as or perhaps a little more than the PAL-D type. We imagine that only the development of an IC which would substantially reduce costs would swing manufacturers in its favour. Even if this happens, the advantage will be mainly economic.

50 WATT GUITAR AMPLIFIER: I have recently been given a circuit for a 50 watt solid state guitar amplifier from the July and August 1969 editions of Electronics Australia. I have obtained 90% of the components, and look like being able to obtain the rest. The only difficulty is in obtaining the driver transformer, type TD32 or TRD258. It seems that they are out of stock. I was wondering if you could possibly give the number or type of a suitable substitute, and where to obtain one? Also, do you know if any readers have had any problems with this project? (R. J. Coburn, 18 Crewe St, Henley Beach, S.A. 5022.)

• Notes and errata for the Playmaster 125 Guitar Amplifier (File Nos 1/GA/17 & 18), appeared in the August 1969, January 1970 and April 1972 issues. Inquiries to the original suppliers of the driver transformer have confirmed that this type is out of stock. We have taken the liberty of printing your full name and address, so that any readers who may know of a source of supply will be able to contact you direct.

COVER PHOTO: I would like to recommend a photograph for the cover of one of your forthcoming issues: the Control Data Corporation's 6600 Cybernet computer. The Control Data building and computer is in Miller St, North Sydney. It caters for Fortran IV, V, Algol, and Basic programming. (J.H., Naremburn, NSW.)

• Thank you for your interest and for the suggestion but there is one problem: computers can be fascinating and exciting to those who are involved with them but they all tend to look much the same in a picture: rectangular cabinets in an impeccably clean room, access terminals and the inevitable female model!

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

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COMPONENTS: We do not deal in electronic components. Prices, specifications, etc., should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

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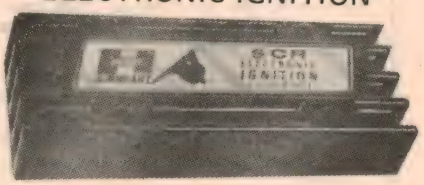

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Serviceman from p. 79

seas. Why should this one set go all temperamental? On the other hand, it was easy to guess how it passed the final test. It would almost certainly have been tested on a dummy load.

But I was able to make one suggestion as to the likely cause. My guess is that the first transistor in the modulator stage has an abnormally good performance figure at 144MHz. This may be simply due to a freak characteristic or, more likely in my view, to an RF type transistor, such as used in the RF chain, somehow being fitted to the modulator. This would be a very easy thing to happen in the hustle and bustle of mass production.

My friend confessed he hadn't thought of that but was keen to check it out. The type numbers were clearly indicated on the circuit so it was only a matter of checking those on the actual transistors. The only snag is that it may be some time before I see him again and can check whether my theory is correct.

But, whatever the cause, I found it a very intriguing story, indicating not only that strange faults can occur in production, but that they can often get through what appear to be the most rigid tests. In fact, the final test of any device is how it performs in the field.

Notes & Errata

LSI DIGITAL ALARM CLOCK (December 1974, File No. 7/CL/16): We have received several queries from readers concerned with an excessive temperature rise in the MM5316 IC, as well as erratic operation of the power supply failure indicator.

Investigations have shown that the temperature rise is due to excessive dissipation in the output transistors. These transistors all have a common source, connected to pin 23 of the MM5316. The dissipation can be limited by inserting a suitable resistance in series with this pin, which is normally connected directly to the Vss rail.

When this is done the current drawn from the Vss rail is reduced and, as this rail is not regulated, the voltage can rise to excessive levels. This must be prevented to avoid damage to the MM5316 chip.

Regulation is most easily obtained by use of a zener diode. This also has the advantage that it is possible to prevent erratic operation of the power supply failure indicator. By ensuring that the Vss rail is kept above 20V, it will always exceed the maximum level of the internal reference voltage, and the indicator will function correctly.

The procedure for modifying the clock, and the parts required, are 1; Remove PCB assembly from case. 2; Cut track between pins 23 and 28 of MM5316, and insert 1k ¼w resistor. 3; Cut track between cathode of D2 and positive end of R34. 4; Cut track betwen positive lead of C2 and positive end of VR1, and insert 120 ohm ¼w resistor. 5; Join positive end of VR1 to pin 36 of MM5316 with insulated hook-up wire. 6; Connect anode of 24V 2.5W zener diode (BZX70C24) to earthed transformer lug. 7; Connect cathode to positive end of VR1. 8; Re-assemble PCB assembly into case, and re-adjust VR1, as detailed in text.

DIGITAL TACHOMETER (Year Book 1975-76, File No. 3/TM/12.) There is a drawing error in the component layout drawing at the top of page 81. Two leads on the left of the board, labelled "T1 collector" and "T1 emitter" are shown connected to the same point. "T1 emitter" should connect to the same point as "+5V to BB". The lower drawing on p. 81 shows pin 5 of IC8, IC9, and IC10 connected to the common rail. This will cause all zeros to be inhibited. Pin 5 should be disconnected in each case, but the common rail must be left intact.

LUCAS SOLAR ARRAYS (December 1975, p. 96): The diameter of the individual wafer cells used in the new arrays is 90mm, not 75mm as quoted.

ELECTRONIC MOSQUITO REPELLER (January 1976). The price quoted for the special offer diodes in the panel on page 51 is incorrect. This should read "50 EM401 silicon power diodes at $2.00 per pkt", as quoted in the text at the bottom of page 50.

Marketplace

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RESISTORS AND CAPACITORS. Packs of 285 resistors. Standard pack contains 5 each of E12 values 10 ohm to 470K in I.R.H. GL ½ metal glaze resistors, (½ watt at 70°C 5%). Computer pack contains selected quantities. All values included. $7 per pack. Individual resistors 3c each, 250 or more 2.5c each. Each value is individually packed so no sorting out required! Phillips ¼ watt carbon film still available, see E.A. November. CAPACITORS. Ceramic 50 volt circular plate. 10, 25, 47, 68, 120, 270, 470, 680 pf and .001 mf 5c each. .0022, .0033, .0047, .01, .02, .047, 8c each. .1 mf 9c each. Ceramic pack contains 80 capacitors being 5 each of values listed. Due to high demand reduced to $4.50 per pack. Polyester "Green Cap" 100 volt .001, .0022, .0033, .0047, .01, 7c each. .022, .033, .047, .068 mf 10c.each. .1 and .22 13c each. Polyester pack contains 5 each of these values for $5.00. ELECTROLYTICS. Uprights 1000, 16 volts, 40c; 35 volts 70c, 2200 mf 16 volts 55c; Pigtails 1000-10 volts 35c; 1000 35 volts 80c; 2200 mf 16 volts 80c 2200 35 volts $1.20. Transistors BC549 6 for $1.00 or 18c each. BC557 6 for $1.00 or 19c each. Diodes IN914A 10 for $1.00 12c each. All components brand new from manufacturers or agents. Each value of component individually packed. Post and packing included in all orders over $6.50. For orders less than $6.50 add 40 cents for post and packing. 5% discount on orders over $35.00; 10% discount on orders over $75.00. Send orders to RAM ELECTRONICS, 575 SYDNEY ROAD, SEAFORTH. N.S.W. 2092. Please enclose cheque or money order.

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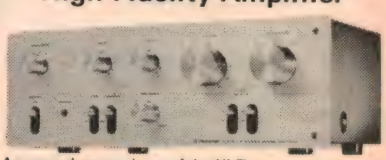

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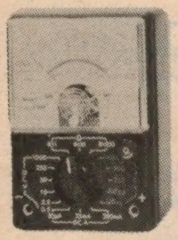

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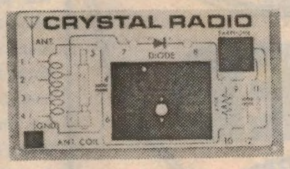

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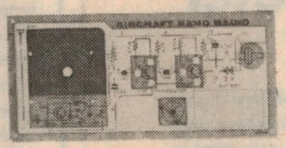

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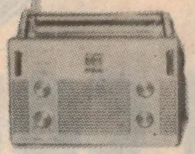

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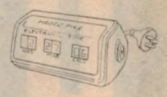

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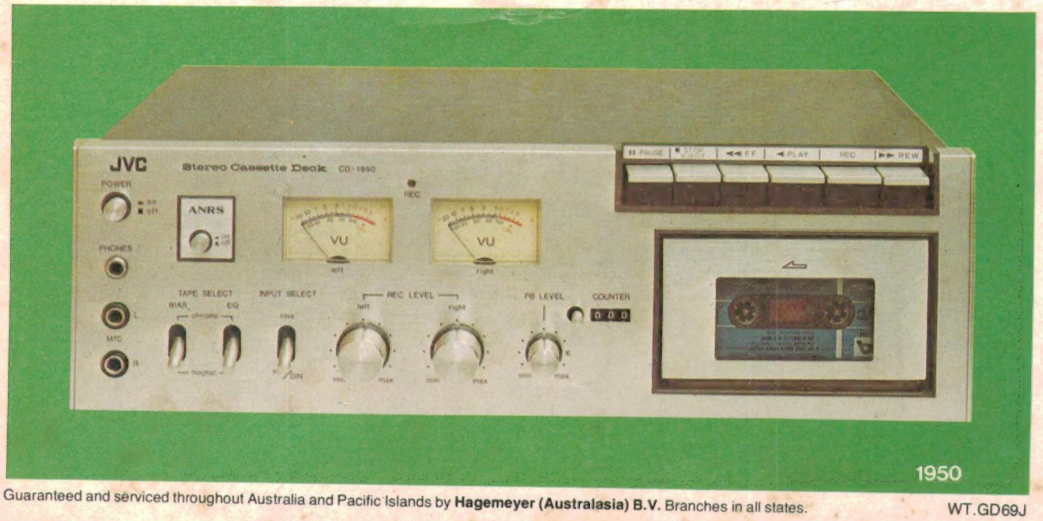

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